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Belgian Congo Grows in the Mining World

By Sydney H. Ball

Developer of the Katanga—Robert Williams

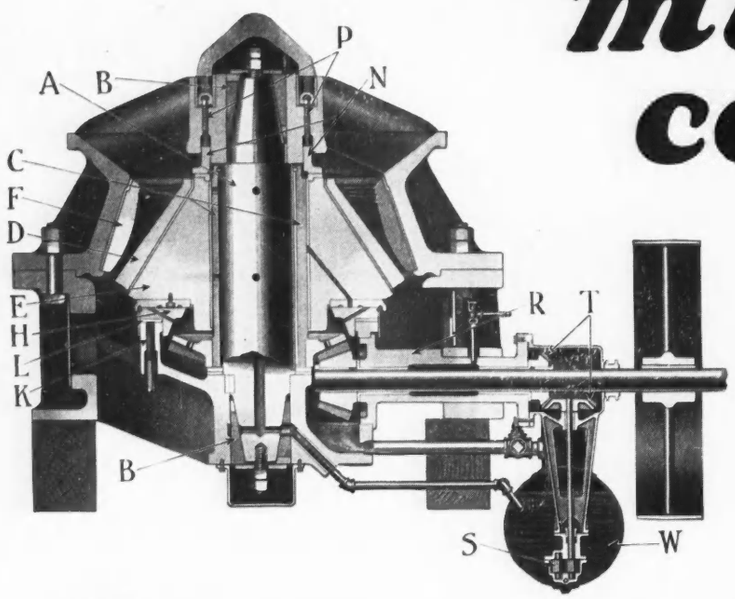
By George L. Walker

Leaching Raw and Roasted Tin Concentrates

By C. G. Fink and C. L. Mantell

Useful Operating Ideas—Consultation—Complete Market Report, with Averages

What goes in must come out



Sectional view of Telsmith Reduction Crusher. A—Central shaft, hollow bored, with taper bushings (B). C—Sleeve eccentric with die-cast babbitt sleeves. D—Manganese steel head mantle, zinced on grey iron core casting (E). Head is adjusted by raising head support (H) by means of two jackscrews (K) inserting or removing shims (L). F—Manganese steel wearing plates. N—Oil sleeve. Kept snug against upper head plate by tightener screws (P). R—Removable countershaft box, equipped with die-cast babbitt bushings and adjustable sight feed. S—Gear pump, driven by steel miter gears (T) lubricated by oil bath from countershaft box. W—Oil storage tank, equipped with removable cover-casting, brass strainer and drain plug.

Telsmith's greater discharge diameter permits a choke, gravity feed

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A Cross Section of Opinion On Reserving War Minerals

FREQUENTLY the assertion has been made, as if it were axiomatic, that apparently limited domestic reserves of essential war minerals should be kept untouched in the ground as a reserve in case of a sudden war, which might cut off imports from foreign countries. An important point for consideration here is the time element; that is, how long would it take after the outbreak of hostilities before production would be sufficient to satisfy domestic requirements. It is only by ignoring this point, it seems, that anyone could regard the statement quoted as axiomatic, for the time element involved makes the proposition highly debatable.

To determine, if possible, the basic soundness of the suggestion, a hypothetical question was framed and submitted to a jury of twelve operators, each of whom has had experience in opening and developing properties and in bringing them to production. The question submitted was as follows:

"Assume that a certain branch of the mining industry is dormant; that the existing mines and plants in this branch are shut down and have been so, perhaps, for several years; that their owners have little hope of resuming work, and that the physical condition of the mines and plants is such as you would expect to find under these conditions.

"Assume also that of the mineral formerly mined at these dormant properties there are likewise deposits, large and small and of varying grade, which have never been opened or developed and about which little is known save the facts afforded by surface indications.

"Now, if you, as an operating man, were suddenly asked to renew work at these old mines and plants, and to open the untouched deposits for the purpose of getting tonnage as soon as possible, would you require a year or two to get into steady production, or do you think that you could begin to produce steadily within a few months? The availability of labor and supplies would of course be a factor."

Of the twelve to whom the foregoing question was submitted ten replied. A perusal of their letters demonstrates that the subject has its complexities, because of which it is difficult to answer definitely the simple question propounded. This in itself is conclusive proof that the proposition under scrutiny is not axiomatic.

One of these operators, in Arizona, says:

"As a general proposition, the reopening of mines or the opening and development of a new mine, and the erection or rehabilitation of proper treatment plants, is a long and difficult matter, requiring years rather than months to accomplish. . . . Whereas, in a few cases, abandoned and dismantled mining properties might be put in operation in the course of a few months, the majority would probably require from one to as much as three years for the accomplishment of this object."

The superintendent of a well-known mine in Nevada writes:

"Most old mines I have had experience with are tough customers and it is difficult to bring them back to life. . . . I will admit there are exceptional cases; but with the ordinary mine, under conditions as outlined in your letter, I believe it would be at least a year, perhaps several, and perhaps an impossibility, to bring it again to a profitable producing stage. The chances are against quick results. I can imagine a mine with ground that stands well, a custom plant in the vicinity, conditions good as to labor and supplies, which mine could be brought to a producing stage in a few months. I can also imagine an old mine, with ground that stands badly, with water to pump, erratic orebodies, no custom mill available, and with poor labor conditions, which mine would give endless grief to the engineer attempting to reopen it, and would cause indefinite delay before it could be brought to the producing stage."

The same operator makes the point that the hypothetical mine would contain various places where an uncertain tonnage of commercial ore was known to exist, so that ore might or might not be developed rapidly.

The chief engineer of a large property in Utah asserts:

"If the property were of considerable size and its workings of appreciable extent, and if there were metallurgical problems to be solved, it would certainly be impossible to reach the productive basis in less than one year; and under the normal scheme of operations, where local difficulties arise with metallurgical problems, machinery delivery, installation and the like, it might easily require two years in which to put the property on a complete productive basis."

On the other hand, a superintendent of iron mines in the Birmingham district says:

"If I were confronted with the task such as you outline, I would promptly rehabilitate the plant and obtain such tonnage as would be available and simultaneously start a prospecting and developing campaign to determine the extent and commercial quality of the deposit, so that the output would show a gradual increase up to a point which would be commensurate with development and probable life."

A California operator, who evidently is thinking of chrome and magnesite when he says "war minerals," writes as follows:

"Very few of the so-called war minerals which do not occur in sufficient quantities to warrant mining under peace conditions occur in deep abandoned mines. It is not a case of reopening old mines, but rather of developing virgin deposits near the surface. Under these conditions it would be easy to start mining operations with very little plant and very little preparations, so that a considerable tonnage could be realized within a month or two. Where expense is of no great importance, the ore could be transported to existing reduction plants."

To illustrate the foregoing the writer cites instances in the chrome industry in California during the war. Chrome occurs in California in small lenses scattered for several hundred miles along the Sierra Nevada mountains, each lens containing only a few hundred tons of ore. It appears axiomatic to this operator that the best way to preserve the so-called war minerals is to leave them in place.

The former manager of a property in Ontario thinks that speed could be made in an emergency. He writes:

"Where you have existing mines and plants that have

been closed down for years, even if they are in a run-down condition, I do not think that one to two years would be required to put them on a regular producing basis. It would be a question of months to get a steady output, which could be gradually increased.

"With regard to deposits which have never been opened and developed and about which little is known except the facts offered by surface indications, I would not like to hazard a definite statement. Each individual property would have to be considered separately. . . .

"Wonderful things can be done in an emergency, particularly a national emergency, when there should be ample supplies of money to speed up work."

The manager of a property in Colorado has a similar idea, but he adds a qualification. He says:

"No doubt at all can exist that time would be a serious adverse factor in resuming operations under the conditions you cite. On the other hand, in national emergency, the best of talent and great resources could be assigned to the task. I believe the time factor not overwhelmingly against leaving such deposits idle.

"I reply to the limited question, assuming actual known scarcity. In another category are those minerals which may exist in presumably low-grade deposits in large quantity, on which by painstaking efforts buoyant industries may be built."

The superintendent of several properties in Arizona thinks that fast work can be done under favorable circumstances. But he says:

"The question of looking for ore would be much more serious than the simple reopening of the mine. . . . It is usually a long and tedious process to open an abandoned mine. The length of time necessary would vary as to the distance from the railroad, the condition of the shaft timber, the amount of water to be handled, the condition of machinery at the mine, and the character of the orebodies. On the average, I would say that if the ore were there, it could be produced in one year."

The manager of mines for a Lake Superior iron company comments interestingly. He says:

"I would expect that an old mine developed in soft ore or soft formation, which had been dormant for years, would require practically new development underground; and this, of course, would take months of time—how many months would depend largely on the extent of the former operation.

"The time necessary to open untouched deposits would, of course, depend on ground conditions. I have known shafts, to sink which, it had been estimated, would require a couple of months in order to penetrate a hundred feet, to take upwards of a year to sink owing to quicksand conditions. Development work in ordinary formation requires an amount of time comparable to the extent of the proposed development. I was asked once how long it would take to reopen a group of four or five mines that had been idle for over a year and to get a heavy production from them. We had an organization of only about 25 men altogether. . . . In a month's time we had over 1,000 men on the payroll and were getting about 80 per cent production, as compared with what we were getting a couple of months later. Here we had all the breaks in our favor in that the mines were not in bad shape physically, and that the labor supply was unusually plentiful, owing to rather quiet times. As an opposite extreme, five years later this district was working under war conditions. The operators were competing for labor; and, in the Cuyuna district, where the manganiferous iron ore was being mined, I would say that efficiency declined fully one-third because of this keen competition.

"If one were to attempt to reopen long-dormant mines that had been developed in soft ore and rock, it is a big question as to how long it would take to get on a fair production basis."

The manager of a prominent copper mine in Arizona expresses the opinion that a surface deposit which could be quarried could be brought into production quickly, provided that means of transportation existed. The time required to bring an underground property into production, however, would depend largely on the amount of new development work necessary. He concludes pointedly as follows:

"If it were desirable to have this material available for immediate production, the essential thing would be to have the original heading driven into the deposit, so that the delay of advancing this single heading could be eliminated and work started immediately at a number of points in the deposit. This would necessitate that the government own the deposit; or, at least, that the government assist the owner in putting in this preliminary development. There would be little inducement for a private owner to do this if no profitable market existed for the product in peace time, or if the owner were prohibited from marketing his product in peace time owing to the necessity of conserving it as a war reserve."

The point made in the last paragraph is a weighty one, and it is urged upon the attention of those who would keep deposits of war minerals, such as manganese, untouched in the ground against a war emergency. As for the argument that in a time of national emergency, such as war, development could be done rapidly because money and labor would be abundant, it should be borne in mind that all the money in the world will not make it possible to put more than two men at a time at the face of a 5 by 7-ft. heading, and that the size of the crew that can be put in a shaft of given dimensions is strictly limited. Besides, it is likely that, in the period of this emergency, labor would be scarce and less efficient.

Accelerating Mineral Production

PRODUCTION of metals and minerals at a profit may be instigated by the love of adventure; or it may be due to a desire to emulate successful enterprise; or it may result from the necessity of making a living. Unchecked, or overstimulated, output may and often does reach a point where production overtops demand. Under such conditions, keen competition affects the most vulnerable feature of marketing—price. Some producers, by virtue of a monopoly or the quality of their output, can protect price; but without either advantage they are at the mercy of buyers and competitors. New producers in established markets become competitors, or must develop new markets, which is not always easy to do.

Almost without exception in the mining industries, productive capacity appears to be ahead of demand, especially with respect to oil and coal. The recent examples of flush production of petroleum and the generally unsatisfactory price of this commodity draw attention to the over-enthusiastic development that has characterized that industry. Also, it is generally admitted that there are too many coal mines and too many coal miners. In the metal-mining industry, price conditions are unsatisfactory; and talk of production curtailment has been current. Likewise, in the non-metallic field, numerous examples may be cited of severe competition, cement and the cruder forms of construction materials such as sand and gravel being also affected. Nevertheless, and in spite of obvious facts, efforts are being made to stimulate interest in new mining ventures. Chambers of commerce in some instances are actively encouraging such projects. *Engineering and Mining Journal* does not seek to decry these efforts, but merely raises the question as to the sufficiency of the study made in each instance. Has consideration been given to the

available market and the adequacy of its supply? Would a new producer be an asset to a community or would he merely take business away from a producer already established? These are questions that apply more particularly to non-metallic minerals and construction materials than to metals, for which an increasing world market is likely.

It therefore seems logical that efforts to improve conditions in the mineral industries should be directed primarily toward increasing existing markets by research seeking new uses, or encouraging industrial development that will provide additional outlets for mineral products. Chambers of commerce, both local and state, can advance mining development materially by consistently developing industries that require raw minerals. On the establishment of such manufacturing industries, the miner and mineral producer can be relied upon to supply, from mineral deposits now available, the new demands.

Peripheral and Trunnion-Discharge Ball Mills

AN ARTICLE in a contemporary, on ball mills, infers, in regard to the method of pulp discharge, that only one basic type is available—with exit through a hollow trunnion. It is true that most ball mills are now built thus; but the inference that no other type exists will tend to deflect attention from initiative and enterprise and to confine future developments in one channel only.

The original peripheral-discharge ball mill was of German design and manufacture. It found wide application throughout the world, mainly for comparatively fine crushing. Its disadvantages lay in high initial cost, complexity of assembly, in the difficulty of obtaining spare parts, and in the necessity for the regulation of feed within narrow limits to obtain reasonable capacity. It is as well to interpolate that these disadvantages have been obviated by the design of a simpler machine. The mills of the Krupp type, however, functioned successfully either wet or dry, although feed adjustment with wet crushing was even more difficult than with dry crushing.

In course of time the peripheral-discharge ball mill was displaced almost entirely by a trunnion-discharge unit, the essentials of which comprise a cylindrical lined body with provision for the entrance of raw material and fluid vehicle as well as exit of pulp along a horizontal line parallel to the axis. The fact that the trunnion-discharge mill was foolproof, low in first cost, and reliable in operation served to deflect all attention from the points of advantage in the peripheral-discharge mill, which advantages include (1) prompt discharge of material as soon as ground fine enough to pass the peripheral screen, and (2) absence of oversize in the final product. In other words, the peripheral-discharge mill crushes and screens in one operation—an advantage that, in the opinion of many, is more than offset by the fact that, under most conditions of wet ball milling, the maintenance of a large circulating load is highly desirable.

In wet grinding, the ability to control the dilution of the pulp in and from an overflow mill is an obvious advantage. In dry crushing, however, particularly in regard to secondary rather than fine crushing and even where the material is slightly damp, an opportunity for the utilization of a simple type of peripheral-discharge screen-type ball mill is often in evidence; and progress will only be hindered by inferring that such a mill is non-existent or that it does not possess obvious applications in some instances.

The Fathers of Selective Flotation

IN HIS BRIEF ANNUAL ADDRESS before the Mining and Metallurgical Society, the president, Mr. Clinton H. Crane, suggested that in view of the wide adoption of selective flotation processes in the last few years some research should be made into the history of this method of treating complex ores, to the end that proper credit should be given to the originators. The marked increase in the application of the selective flotation process in North America which has occurred in the last two or three years suggests that little progress had been made previous to 1925, but we must go back much further, not only in tracing the origin of the idea but in seeking for the first commercial installation. North American metallurgists, clever as they have been in developing new reagents, machines, and processes recently, were as slow to experiment with the possibilities of selective treatment as they were to work with the earlier methods of straight flotation.

The Sunnyside company, in the San Juan district of Colorado, is generally credited with being the first to operate a commercial mill in North America that floated selectively two minerals from a complex ore. This was about 1918. Shortly following this, important work was done in this field by the Consolidated Mining & Smelting Company at Trail, B. C., and by the Timber Butte Milling Company, at Butte. The discoveries made by metallurgists at these three plants perhaps were the most important of any that resulted from the early work on this continent.

But long before this, the Australian metallurgists, working at Broken Hill, had progressed from straight flotation of zinc in table tailings, to a selective separation of the lead and zinc in the same material, and even in mine ore. Several processes were developed in which a flash roast deadened the surfaces of the more easily affected sulphides, a cleaner concentrate thereafter being obtained by flotation. This, however, was not the method destined for success, so let us rather see who were the fathers of selective flotation as we know it today.

Judging from the records available, it would seem that credit should be given H. H. Greenway, A. H. P. Lowry, F. J. Lyster, and Leslie Bradford. Greenway and Lowry, in 1913, patented a method whereby bichromates or chromates were added to depress lead while zinc was floated. They advised a pulp made alkaline with sodium carbonate. Lyster did just the opposite: he added reagents to depress the zinc while floating the lead, suggesting a rather wide choice, including the sulphates, chlorides, nitrates, or hydrates of calcium, magnesium, sodium, or potassium, the pulp being very slightly alkaline for best results. Bradford developed the use of chlorides of the alkalies or alkaline earths—as common salt—one of the group proposed by Lyster, but with a slightly acid pulp. Thus he floated sphalerite and retarded galena—just the opposite of Lyster's result in an alkaline solution. Subsequently he used sulphites, thio-sulphites, and sulphurous acid.

Cannot some of our Australian friends give us some of their reminiscences concerning this early work fifteen years or so ago? Has any one been overlooked, and where should most credit be bestowed?

Mining Men of Note

Robert Williams

THE development of the Katanga copper belt is to be attributed to a great personality. Of the several who rediscovered that district after its phenomenally rich ore deposits had been worked for untold ages by the natives, Robert Williams was the only one wise enough to know what he had found when he found it. He is now vice-president of Union Minière du Haut-Katanga. The president, Jean Jadot, has said of him: "He is, in fact, the promoter of our company, and I must tell you that during the twenty years or nearly during which I have worked with him, we have always been on terms of the greatest friendship and cordial collaboration."

ROBERT WILLIAMS

The career of Robert Williams is a study of remarkable foresight and determination. Left fatherless at six, his character was formed early. Constant association during his boyhood with his grandfather, a great shipbuilder, trained his mind to the world-wide viewpoint. His chosen profession of engineering already was well grounded when in 1875, at the age of fifteen, he entered the drafting-office of Blaikie Bros. in Aberdeen, Scotland. Six years later, on the recommendation of that firm, he went to Kimberley, South Africa, to take charge of the engineering works of M'Kenzie & Anderson. Engineering work he did for several mining companies of Kimberley and the Rand attracted the attention of the late Cecil Rhodes, who selected Williams for a lieutenant in his Cape-to-Cairo railway scheme. Williams returned to Scotland to take a metallurgical course. Then Rhodes sent him north to search for minerals, for deposits that would justify and assist the extension of the railway. He reported favorably on the ancient gold-quartz workings of Southern Rhodesia. The railway was extended, and Southern Rhodesia has since produced some $350,000,000 of gold. After the death of Cecil Rhodes the plans of that great Empire Builder were carried forward by Williams. As the Rand was on the divide between the Limpopo and Orange rivers, Williams directed his attention to the similar watershed between the headwaters of the Congo and Zambesi. In the works of Livingstone he learned of the great copper field there, and sent an expedition to examine it. From then on the remarkable ability of Williams manifested itself. He went personally to King Leopold of Belgium and asked for a concession. The King smiled and said in effect: "I too have had those ore occurrences examined. They are valueless. You are wasting your time and mine." That would have sent any other man home with his heart in his boots; but Williams did not go home till he had the desired concession in his pocket, and with it *the King's agreement to supply half the money* required to explore it! The Williams grasp of the situation is proved by dates. Union Minière was organized in 1906. Only two years later he had arranged to build the Benguella Railway, directly in from Lobito Bay on the west coast to Katanga. The following year, 1909, he financed through his own companies and built the Rhodesia Katanga - Junction Railway, extending the Cape-to-Cairo line north to the Congo border, this giving Union Minière its first all-rail outlet to the east coast and to Cape Town. Despite this rail connection and a rail-and-water route being opened down the Congo, Williams continued to build the Benguella Railway. Opposition arose, the story of which already has been told, but Williams won the confidence and respect of the several governments he was obliged to negotiate with, and in November last the locomotives of the Benguella Railway ran up to the Angola-Belgian Congo border. The need of this railway is now so urgent that the Belgian Congo government has bought the rails and will hasten its extension to the mines. It will make a total of over 3,000 miles of new railway construction in Africa for which the Williams activities are responsible.

The city of Aberdeen, where he was born, made Robert Williams a Free Burgess recently, adding his name to a roll of honor containing those of Stanley, Roberts, Haig, Cowdray, Mount Stephen, Strathcona, Doctor Johnson and others of world-wide fame. Nearly 2,000 neighbors and friends, including prominent Belgians and Portuguese, assembled to witness the dedication.

"His selection as a Freeman," *The Aberdeen Press and Journal* said, "is one of the most popular ever made."

Belgian Congo Grows in Mining World

Leading Producer of Radium and Cobalt, Second in Diamonds, and Third in Copper

By Sydney H. Ball
Mining Engineer, 26 Beaver St., New York City

FIFTY YEARS after Henry M. Stanley, the first man to explore the Congo River, reached the Atlantic Ocean in 1877, the Belgian Congo, with a white population of 18,169, was the most important producer of radium and cobalt in the world, second as a producer of diamonds, and third as a producer of copper; and it was gaining a place in the first flight in the production of gold and tin. The value of the mineral production of the colony is well over double that of our own important mining territory—Alaska.

Fifteen years ago to the man on the street in Brussels, the Belgian Congo appeared to be a bottomless pit in which he feared his taxes might disappear. Today the same man looks upon the colony as an El Dorado, the fecund source of raw material for Belgian factories.

Diamond-washing plant of the smaller type

Early in 1927, the colonial shares on the Brussels Exchange (and all colonial stocks are by no means quoted) had a value of about $350,000,000. In 1926 there were paid on these shares dividends amounting to $5,600,000, of which, through share ownership, the colony received 40 per cent. The low rate of return represents the confidence of the Belgian investor in the future expansion of colonial enterprises. New issues and increases of capitalization of old companies, as they appeared during the year, were largely oversubscribed.

The colonial budget for 1928 provides for the expenditure of about $25,000,000 on public works of various kinds. During 1927 the various railroads now under construction made normal progress, and it is expected that the "all-Congo" route from the Katanga copper belt to Port Francqui (the Bas-Congo-Katanga Railroad) will be completed in 1928 and connection between the copper mines and the Benguella Railroad two years thereafter. At that time, the center of copper mining, Elisabethville, will be the turntable of Central Africa, serving not only the Belgian Congo itself but adjacent parts of Rhodesia as well.

The Belgians are not exceeded in enthusiasm for aviation by the people of any other nation, and the service between the Atlantic Ocean and the copper fields operates regularly. From time to time both gold and diamond shipments are made by plane.

In 1927 the Union Minière du Haut-Katanga produced approximately 88,000 long tons of copper, a satisfactory increase over the 1926 production. During the first six months of the year, production was below normal; all efforts were being put forth to further the construction program, particularly that of the reverbera-

Period	Blister, Long Tons
1911—19	128,547
1920	18,897
1921	30,455
1922	43,318
1923	56,479
1924	85,570
1925	90,020
1926	80,639
1927	88,000

tory furnaces. Increase in production since June has been marked. The company is the sixth copper mine of the world and accounts for some 6 per cent of the world's production. The table above gives the production for recent years.

On Dec. 31, 1926, the ore reserves were reported as 77,160,650 tons with a copper content of 6.89 per cent.

The stage seems set for an appreciably increased production of copper by the Union Minière in 1928, and the company's future appears bright. According to report, the labor situation has improved somewhat over that of 1926 and at present about 16,000 blacks are employed. The number of native residents at the various mines has increased, and as the construction program nears completion the proportion of laborers available for exploitation will increase. Substitution of coal for wood alone will release 4,000 woodcutters for other departments. Many more laborers should be available on the completion of the Bas-Congo-Katanga Railroad. Further, the improvement in mining and milling machinery should increase the man-month rate of production.

A gold placer of the Northeast Congo in early stages of development

The large construction program of the company is in part completed. In September, the first of the reverberatory furnaces was put into operation, and others will follow until this unit has a capacity of from 30,000 to 40,000 tons a year. All furnaces are being equipped with automatic ash ejectors. The first unit of the Mineral Separation commercial-sized flotation plant started operation in July. The company is to use palm oil in flotation, which it will produce from its own plantation west of Lake Tanganyika.

The Panda mill has a crushing capacity of 4,000 tons, and the concentrator consists of three independent and identical sections, each of a capacity of 1,200 to 1,400 tons per 24 hours. The daily product is 600 tons of concentrates containing from 20 to 22 per cent copper. The mill is driven by steam-generated electric power and has a complete repair shop. The ore treated in the mill contains from 7 to 10 per cent copper, the high-grade ore, say 16 per cent, being smelted direct, as are the concentrates of the mill. Lower-grade ore, carrying from 5 to 10 per cent copper, is to be treated in the leaching plant at Panda, which presumably will be completed in 1928. It is expected that the lead necessary for the leaching plant will be produced from the Kipushi mine. Sulphuric acid will be produced by a subsidiary soon to be formed, the "Société des Produits Chimiques du Kantanga." To begin with, at least, the acid will be made from imported sulphur.

As stated before, transportation will be greatly improved by the completion in 1928 of the Bas-Congo-Katanga Railroad, and the delays from strikes and car shortages experienced when the mines were dependent upon a single railroad will disappear. In 1926 about 80 per cent of the company's copper was shipped out by the South African railroads and the remainder reached Europe by Dar-es-Salaam. Upon the completion of both the Bas-Congo-Katanga and Benguella railroads, the greater part of the freight of the copper belt will be divided between these lines.

In 1926 the copper produced appears to have cost under 10c. a pound. With the improved facilities for treatment already completed or under construction, a higher recovery and a lower cost should be attained, but this decrease will be wholly or in part offset by the lower grade of ore which will presumably be treated. The new routes to the sea, however, are expected by Belgian engineers to reduce the freight cost by 1.4c. per pound. In 1928, however, the holders of common shares must divide the profits for the first time with the preferred share- and bond-holders, so that perhaps lower costs will be of no direct benefit for the time being to the holders of the common shares.

In 1927 Sogefor, the hydro-electric power subsidiary of the Union Minière, which is to furnish power for the Panda leaching plant, completed much of its preliminary work, including hydro-electric surveys, roads, camp installations, and railroad connections.

To the north of the copper belt, the Union Minière operates the Busanga alluvial tin property. The cassiterite obtained by sluicing is bagged and transported by motor trucks to the railroad. In 1926 production was 710 tons of cassiterite, the production being less than that of 1925 (854 tons), owing to labor shortage.

Union Minière has been the world's principal producer of cobalt since 1925, and as a result of its competition, Canadian production has been somewhat reduced. The Canadian and Belgian producers now supply the world's demand, which is from 600 to 700 tons per year. The cobalt ore, an oxidized copper ore, with from 4 to 5 per cent cobalt, is obtained from the Ruashi mine and is electrically smelted at Panda into an alloy containing 25 per cent iron, 30 per cent cobalt, and 30 per cent copper. The alloy is refined in Belgium by a wet process.

The world's demand for radium approximates 25 gm. yearly, and Belgian Congo has a monopoly in the production of this metal. Katanga's ore reserves are large and rich, and the company's refining plant in Belgium has a capacity of from 50 to 60 gm. per year. The principal use of radium is for the treatment of cancer, although from 4 to 5 gm. are used annually for luminous paints. The company had sufficient stocks on hand, and in consequence the refinery was not operated in 1926, but it was reopened in October, 1927. It is stated that in the treatment of King Ferdinand of Rumania the Belgian company was called upon at short notice to supply almost 6 gm. of radium.

Most of the Union Minière products are refined at the plants of its sister company, the Société Genérale Metallurgique de Hoboken, located near Antwerp. This treats all of the Congo tin, radium, and cobalt and refines its gold. At present Katanga copper is refined largely in America, and only in part in Europe. The first unit of the company's copper refinery, however (32,000 metric tons), will presumably be finished early in 1928, and the second similar unit late in 1928. The metallurgical company made a gross profit in its fiscal year ending June 30, 1927, of 14,304,785 francs.

Two other companies in addition to the Union Minière work alluvial tin mines in the Katanga, the Geomines, which in 1926 produced 728 tons of cassiterite, and Simkat, which produced 180 tons. The latter company made a net profit of 1,532,103 francs in 1926. The Geomines production for 1927 was well over 1,000 tons presumably, as its improved plant was in operation. In 1927 the colony's production of cassiterite, containing 72 to 73 per cent tin, probably approached 1,900 tons.

The Geomines has coal mines at Grenerville, in the eastern part of the colony, important tin placers in northern Katanga, and interests in the Luena coal field and the Lueta Diamond Company. The principal tin mine is Manono, and its gravels are reported to contain from 1 to 7 lb. per ton. At the end of 1925, the reserves were equivalent to 25,000 tons of cassiterite, but development since that time has presumably increased them. Profits covering operations for the year ended June 30, 1926, were 10,434,632 francs, and for the year ended June 30, 1927, 16,650,623 francs.

Last year the Belgian Congo is estimated to have produced approximately 130,250 oz. of gold, a slight decrease from the preceding year's production. Almost 90 per cent of the production comes from the Kilo-Moto mines.

The Société des Mines d'Or de Kilo-Moto was formed on Feb. 8, 1926, to take over the mining concessions of the "Régie," which formerly operated the Kilo-Moto gold placers for the state. The production of these two placers since their discovery is shown in the table below:

Gold Production in Ounces

Year	Kilo Mine	Moto Mine	Total
1905–10	77,258	.....	77,258
1911–1920	445,072	337,949	783,021
1921	38,435	33,202	71,638
1922	40,688	33,622	74,310
1923	60,290	40,872	101,163
1924	69,804	46,122	115,926
1925	65,423	44,529	109,952
1926	65,552	51,621	117,174
1927	.....	.....	115,000
Totals	862,524	587,921	1,565,445

It may be added that since the McIntyre Porcupine Mines, Ltd., the third gold producer of North America, began operations, in 1912, its total production and that of these placers for the period 1912-1927 are closely comparable. The McIntyre's present production rate is larger.

Kilo-Moto's slight decrease in estimated production for 1927 is attributable to the large amount of building and road construction, essential to the expansion of the production. This required the withdrawal from exploitation of labor, which at best is none too abundant. Of the 1926 production, 10 per cent, or 12,052 oz., came from the vein mines. In 1926 receipts were 77,499,073 francs. The costs were 20,928,191 francs, leaving a profit of something over 56,500,000 francs.

Reserves now blocked out are reported to be over 1,671,800 oz., and the possibilities of the concession are not as yet exhausted. It is stated that at certain of the placers, a content of 25c. per cubic yard covers costs. The white staff approximates 200, and about 21,000 blacks are employed. A small dredge was to have been turned over for the first time in 1927 and the number of Chilean mills was to be increased to eight. Interesting experiments were carried on as to the flotation of the gold ore.

Employees of the Union Minière dancing after the day's work

The Minière des Grands-Lacs increased its capitalization during 1927 from 10,000,000 to 20,000,000 francs. Inasmuch as part of its prospecting rights expired in

1927, the company confined itself largely to prospecting and to finally delimiting the most favorable part of its concessions. It has already received mining rights from the government to over 1,000,000 hectares, or about 3,900 square miles. The principal discoveries in 1927 were two gold-platinum placers and a gold placer in the eastern part of the colony, where all the properties of this company are situated. In 1925 the company made a profit of 306,576 francs and in 1926 of 3,794,117 francs, but as yet has not paid dividends. In 1926 it produced 12,538 oz. of gold, about a ton of cassiterite, and 7,040 oz. of sapphire and corundum. Gold production for the year will probably approximate 13,200 oz. The company will have an important participation in the Comité National du Kivu, formed to exploit its concession and the rest of the Kivu, eastern Congo.

The Société Minière de Tele, a subsidiary of the Forminière, continued to exploit the Yambenda and Senguli placers of the Société Minière de L'Aruwimi-Ituri. These mines in 1926 produced 2,893 oz. of gold, but their 1927 production was presumably about 1,450 oz. Preparations are being made to open up two other placers. The Aruwimi-Ituri company made in 1926 a profit of 780,107 francs. The Tele company, operating its own mines, produced in 1926 about 5,079 oz. of gold, but its 1927 production will presumably be only 1,200 oz. These two companies employ about 20 white men and 1,500 blacks.

The Tele also is prospecting in the northeastern part of the colony for the Interfina, and, gold having been found, a prospecting area of 1,930 square miles has been located. In October it formed a subsidiary, Société Minière de Surongo, to open up its mines and to continue prospecting. The Interfina has also obtained prospecting rights in the Ruanda-Urundi region. Prospecting in the eastern and northeastern parts of the colony for the Belgika is also being carried on by the Tele. The Syndicat Minière Africain is prospecting near Doruma, on the headwaters of the Uele.

Besides the Interfina the following have obtained prospecting rights in the mandated area of Ruanda-Urundi: Société Générale de Belgique, the Banque de Bruxelles, Messrs. Van Santen and Van den Broek, the East African Trust Company, Ltd., Tanganyika Goldfields, and Gerard W. Williams.

Ciments du Katanga during 1927 increased its capital to 15,000,000 francs, and its production will be increased in 1923 from 15,000 to 35,000 tons of cement per year. In 1925 and 1926 profits were respectively 2,900,526 and 4,330,509 francs. The Union Minière is a large stockholder, and its construction program assures the company a market. It may be worth noting that a short time ago the price received was about $4.30 a barrel.

The diamond mines of the Kasai region enjoyed a prosperous year in 1927, but owing to the large South African diamond production no effort was made to exceed the 1926 production, which approximated 1,100,000 carats. The Forminière company cut its production to approximately 235,000 carats. Beceka company again produced something over 700,000 carats, and the Luebo and Kasai companies, which have pooled their interests with those of the new company, the Lueta, slightly increased their combined production to about 140,000 carats. At the end of 1926 the latter combination was operating ten mines and seven development centers, and was employing 51 whites and 5,680 blacks. The Diamang company, on the other hand, which operates in Angola and produces exceptionally good stones, increased its production from 154,369 carats in 1926 to about 170,000 carats in 1927. These companies, which are the largest employers of black labor in Africa, are all dividend payers.

One of the large items of expenditure in operating the Kasai diamond fields is that of safeguarding the health of its native laborers. Twelve doctors and numerous nurses, both white and black, care for the sick in twenty hospitals with 500 beds, scattered throughout the field. In addition, the companies have for four years carried on a vigorous campaign against sleeping sickness; their efforts, involving the expenditure of many millions of francs, have been crowned with success, but nevertheless were recently intensified. Three doctors, four sanitary agents, and a large number of black nurses form an itinerant medical corps which examines the natives in their villages and treats those infected with the disease. In the colony there are about 170 doctors, with 340 nurses and other medical assistants.

The Congo companies have produced, to the end of 1927, the following quantities of diamond: Forminière (1913-1927), 2,332,000 carats; Beceka (1920-27), 2,603,000 carats; and Kasai-Luebo-Lueta companies (1920-27) 443,000—a total of 5,378,000 carats. The Diamang (1916-1927) has produced 1,030,000 carats, so that the total production of the Central African fields to the end of 1927 was 6,408,000 carats.

Chinese Production of Antimony Not Lessened by the Revolution

DESPITE military operations at and near the center of production, increased export taxes, and the decline in the price paid by consumers in 1927, it is evident that the output of antimony in China did not decrease during 1927, compared with 1925 and 1926, according to the U. S. Department of Commerce. Exports, however, were apparently less than in 1926. The exact tonnages warehoused are unknown.

Although the output last year was not diminished, handicaps to antimony production in the Hunan region were present almost constantly. Since July, 1926, the increase in the wages of laborers, commandeering and interruption of traffic by the military, and imposition of new and additional taxes have tended to affect the Hankow price. Practically all of the mines in Hunan employ the old Chinese method of production, as do the smelters—the outstanding exception being the Tang mine, at Yiyang.

Producers generally experienced difficulty during the third quarter of the year in obtaining foreign chemicals required in the purification of their product, and many smelters, for the time being, used inferior Chinese substitutes. As a result, antimony regulus less than 99 per cent pure made its appearance on the market, and it is estimated that 2,000 to 3,000 tons of the inferior grade were placed abroad before it was discovered to be below standard. This condition has been corrected, and since October no regulus below the 99 per cent grade has been produced for export.

Reports were circulated in the Changsha-Hankow district to the effect that in South America and England regulus of an extremely fine and uniform quality was being produced and that the material was receiving the favor of American trade to the detriment of the Chinese product.

Experiments in Leaching Raw and Roasted
Tin Concentrates and Tin Oxides

Fourth of a Series of Six Articles Based on Physico-chemical Studies in the Metallurgy of Tin

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THIS WORK was undertaken with the purpose of attempting to find some single substance or combination of substances which, in aqueous solution, would dissolve stannic oxide. It it be possible to dissolve native stannic oxide with some solvent or combination of solvents, the foundation will then be laid for a leaching process for extraction of tin from its ores or, in other words, the hydrometallurgy of tin. It was also hoped that the work might throw some light on the mechanism of the secondary enrichment of tin ores. F. W. Clark ("Data of Geochemistry." U. S. Geological Survey Bulletin) states that the solubility of cassiterite is indicated by several natural deposits. Cassiterite has been noted in opaline deposits, from hot springs, as pseudomorphs after feldspar, cappings on quartz crystals, and in stalactitic forms.

A hydrometallurgical process for recovering tin analogous to those processes used on copper by the Chile Copper Company at Chuquicamata, or the New Cornelia Copper Company at Ajo, would profoundly affect the tin industry. The leachable copper ores occur as acid soluble basic sulphates, carbonates, oxides, or chlorides. Cassiterite has long been regarded as one of the most insoluble compounds known. There seems to be some geologic evidence, however, that there may have been secondary enrichment of veins by solution, transportation, and deposition of cassiterite.

It was not considered sufficient to attempt merely to leach tin concentrates. At the same time it was found desirable to treat pure tin compounds, such as occurred in the concentrates, with the same leaching solutions that were allowed to act on the concentrate. To determine the effect of grinding, pulverized concentrates were also leached; and to determine the effect of roasting, with its subsequent changes in the composition of the compounds in the ore, roasted concentrates were subjected to the same leaching solutions as the ore. To sum up, the following materials were treated with the same leaching solutions:

A. Unground, unroasted Bolivian concentrates (hereafter termed raw concentrates) of the following analysis:

Component	Per Cent		Per Cent
Sn	67.95	which is equivalent to SnO_2	86.2
Fe	4.19	which is equivalent to Fe_2O_3	5.96
Sb	0.04		
As	0.01		
Cu	0.036		
Bl	0.296	which is equivalent to Bi_2O_3	0.33
WO_3	1.42		
SiO_2	1.73		
S	0.28		

B. Raw concentrates of the above analysis pulverized in a ball mill so that the average maximum particle size was 1.0 μ.

C. Unground roasted concentrates—particles retained on a 10-mesh standard Tyler screen. This material is the raw concentrates which had been roasted in Duraloy or ferrochrome crucibles for three-quarters of an hour at temperatures from 900 deg. C. to 1,100 deg. C. This roasted material was in part magnetic and black in color in contrast to the red color of the raw concentrates.

D. Stannic oxide of the J. T. Baker analyzed grade. Average maximum occurring particle size was 1.8 μ.

E. Black stannous oxide of the J. T. Baker analyzed grade. Average maximum occurring particle size was 1.5 μ.

Leaching was done by weighing 10 gm. of the substances into flint-glass oil-sample bottles of 4-oz. capacity. All determinations were made in duplicate. This resulted in the use of ten bottles for every leaching solution, inasmuch as there were duplicate samples. Each test took 100 c.c. of the leaching solution. The bottles were stoppered with paraffined corks, wired in place to hold them during agitation. The agitation was provided by a shaft and clamp agitator, the oil-sample bottles being held in place in the jaws of universal clamps which were, in their turn, clamped on to a $\frac{5}{8}$-in. steel shaft, rotating at 36 to 38 r.p.m. The bottles were so placed that the ends traveled on the circumference of a circle of 9-in. radius. The shaft was driven by a $\frac{1}{3}$-hp. d.c. shunt-wound motor with a speed of 366 r.p.m.; it was connected to the shaft by means of back gearing and a 16-in. pulley on the shaft, so that there was a speed ratio of about 10:1. This speed was selected after experimental data showed that it was just slow enough to allow the particles to fall through the whole length of the bottle twice per revolution and yet fast enough to keep the particles in constant agitation. Agitation was continued for at least two weeks, twenty-four hours of the day. Many of the solutions remained in contact with the solid materials for as long as six months to a year before analyses of the solutions were made. All this work was done at room temperature of 20 to 25 deg. C.

Dissolution of the stannic oxide, if effected at all, may be presumed to take place in several different ways. It may, perhaps, get into solution as a salt, such as a stannate, or, by reduction to the stannous form, in which it is fairly readily soluble, or by chemical reaction, in which the oxygen is replaced by another element, result-

Table I—Results of Tests Showing Solubility of Tin Oxide and Concentrates in Various Solvents

Run No.	Leaching Solution	Solubility 3/100	Concentration g/l	SnO		SnO_2		Concentrates					
								Raw		Roasted		Ground	
				No.	Grams Tin per Liter	No.	Grams Tin per Liter	No.	Grams Tin per Liter	No.	Grams Tin per Liter	No.	Grams Tin per Liter
11	$FeCl_3 \cdot 6H_2O$ — $\frac{M}{10}$	246	27.0	11	1.04	13	0.05	15	0.04	17	0.05	19	0.05
21	$FeSO_4 \cdot 7H_2O$ — $\frac{M}{10}$	32.8	27.8	21	2.14	23	0.04	25	0.03	27	0.05	29	0.03
31	$Al(NO_3)_3 \cdot 9H_2O$ — $\frac{M}{10}$	Very soluble	37.5	31	.....	33	0.00	35	0.00	37	0.00	39	0.00
41	$(COOH)_2$ — $\frac{M}{10}$	.....	12.6	41	1.16	43	0.10	45	0.10	47	0.19	49	0.04
51	NaF — $\frac{M}{2}$	4.0	21.0	51	1.85	53	0.25	55	0.13	57	0.10	59	0.10
61	$Fe_2(SO_4)_3$ — $\frac{M}{10}$	Very soluble	40.0	61	62.60	63	0.17	65	0.25	67	0.10	69	0.30
71	$MgSO_4$ — $\frac{M}{10}$	26.9	24.7	71	0.41	73	0.00	75	0.04	77	0.02	79	0.01
81	Na_2SO_3 — $\frac{M}{10}$	14.1	25.	81	0.11	83	0.27	85	0.02	87	0.01	89	0.02
91	$KHSO_4$ — $\frac{M}{10}$	36.3	13.6	91	2.07	93	0.22	95	0.05	97	0.06	99	0.01
101	NH_4Cl — $\frac{M}{1}$	29.4	53.5	101	0.25	103	0.01	105	0.14	107	0.00	109	0.04
111	$SnCl_2$ — $\frac{M}{1}$	118.7	225.7	111	.....	113	Loss	115	Loss	117	Loss	119	Loss
121	$CaCl_2$ — $\frac{M}{1}$	49.6	75.5	121	0.54	123	0.13	125	0.14	127	0.10	129	0.08
131	KCN — $\frac{M}{1}$	122	65.0	131	0.27	133	0.05	135	0.30	137	0.10	139	0.15
141	26% NaCl — Sat. $Pb.Cl_2$	260	260.0	141	1.10	143	1.03	145	0.27	147	0.29	149	0.08
151	HCOOH — 20%	.....	200.0	151	29.95	153	0.02	155	0.04	157	0.06	159	0.04
161	Na CNS — 2M	Very soluble	40.5	161	.....	163	0.07	165	0.03	167	0.03	169	0.03
171	$HC_2H_3O_2$ — 2M — Sat. Cl_2	.....	120.0	171	51.04	173	0.04	175	0.08	177	0.07	179	0.04
181	H_2SO_4 — 2M — Sat. Cl_2	.....	196.0	181	139.35	183	0.48	185	0.04	187	0.03	189	0.04
191	I_2 — Sat.	0.18	3.0	191	0.84	193	0.06	195	0.08	197	0.08	199	0.06
201	Br_2 — Sat.	4.17	16.0	201	3.07	203	0.08	205	0.10	207	0.10	209	0.04
211	Na Cl — $\frac{M}{2}$ — Sat. Cl_2	29.3	29.0	211	0.55	213	0.20	215	0.12	217	0.10	219	0.11
221	NH_4Cl — $\frac{M}{1}$ — Sat. SO_2	29.4	53.5	221	0.24	223	0.07	225	0.04	227	0.06	229	0.05
231	$(NH_4)_2SO_4$ — $\frac{M}{1}$ —Sat. Cl_2	71.0	13.2	231	8.86	233	0.03	235	0.02	237	0.03	239	0.05
241	$FeCl_3$ — $\frac{M}{1}$ — Sat. Cl_2	246.0	162.4	241	24.04	243	0.18	245	0.13	247	0.11	249	0.11
251	$MnSO_4$ — $\frac{M}{1}$	53.2	151.0	251	3.40	253	0.04	255	0.03	257	0.02	259	0.02
261	Na_2SO_4 — $\frac{M}{3}$ — Sat. SO_2	5.02	47.3	261	.....	263	0.07	265	0.03	267	0.02	269	0.04
271	$NaHSO_3$ — $\frac{M}{1}$	.....	104.0	271	.....	273	0.10	275	0.07	277	0.03	279	0.04
281	NaCl — $\frac{M}{2}$ — Sat. SO_2	35.70	29.25	281	.....	283	0.10	285	0.03	287	0.02	289	0.03
291	$NaHSO_3$ — $\frac{M}{1}$ — Sat. SO_2	.....	104.0	291	.....	293	0.14	295	0.07	297	0.03	299	0.03
301	$NaHSO_4$ — $\frac{M}{1}$ — Sat. SO_2	50.0	120.1	301	1.10	303	0.50	305	0.09	307	0.06	309	0.06
311	$NaHSO_3$ — $\frac{M}{1}$ — NaOH — 2M	.....	.....	311	5.38	313	2.05	315	0.07	317	0.07	319	0.07
321	$(NH_4)_2S$ — $\frac{M}{1}$	100	68.2	321	0.31	323	0.31	325	0.16	327	0.09	329	0.10
331	$NaHSO_4$ — $\frac{M}{1}$ — Sat. Cl_2	50	120.1	331	28.30	333	0.30	335	0.09	337	0.11	339	0.09
341	$CuSO_4$ — $\frac{M}{2}$	20	79.8	341	1.15	343	0.50	345	0.05	347	0.04	349	0.04
351	Na_2Sx — Sat.	20.0	160.0	351	.....	353	32.00	355	0.80	357	0.70	359	0.75
361	Na_2S — Sat.	15.4	154.0	361	.....	363	31.36	365	0.87	367	0.74	369	0.68
371	Aero Cyanide (50% NaCN) Sat.	.....	100.0	371	0.30	373	1.07	375	0.06	377	0.03	379	0.06
381	H_2SiF_6 — 20%	.....	200.0	381	.....	383	0.47	385	0.42	387	0.21	389	0.21
391	H_2SO_4 — 15%, NaCl, 5%	.....	150.0	391	125.00	393	5.41	395	0.89	397	0.70	399	0.26
401	H_2SO_4 30%, $FeSO_4$, 30%, NaCl 5%	.....	.....	401	132.50	403	3.50	405	0.50	407	0.60	409	0.52
411	H_2SO_4, 10% NaF 4%	.....	.....	411	140.00	413	0.38	415	0.45	417	0.47	419	0.42
421	H_2SO_4 20% NaF 4%	.....	.....	421	140.20	423	0.40	425	0.42	427	0.38	429	0.25
431	$FeSO_4(NH_4)_2SO_4 \cdot 6H_2O$ — $\frac{M}{2}$ — Sat. SO_2	....	196.0	431	1.56	433	0.17	435	0.20	437	0.20	439	0.10
441	HCOOH — 10%	.....	100.0	441	20.59	443	0.09	445	0.09	447	0.08	449	0.07

ing in a soluble compound of tin. The substances used for leaching may be divided into various classes:

1—Strong acids, such as sulphuric or hydrochloric.
2—Weak acids, such as acetic or oxalic.
3—Strong bases, such as sodium hydroxide or barium hydroxide.
4—Weak bases, such as ammonia.
5—Salts; which may be divided into neutral, as sodium chloride; acid, as sodium acid sulphate; or basic—those resulting from a weak acid and a strong base, such as potassium cyanide.
6—Oxidizing agents, such as chlorine or bromine.
7—Salts which are reducing agents.
   a. Those whose reducing properties are due to the basic part of the salt, as ferrous sulphate.
   b. Those whose reducing properties are due to the acidic part of the salt, such as sodium sulphite.
8—Salts which are oxidizers, divided into those whose oxidizing properties are found in the basic part of the salt, such as ferric chloride, and those whose oxidizing properties are found in the acidic part of the salt, such as sodium nitrate.
9—Combinations of the above groups in many possible ways, such as neutral salts in saturated sulphur dioxide or saturated chlorine solution, to take merely one of many examples.

TABLE II.—MISCELLANEOUS SOLVENTS

Leaching Solution	SnO_2 Grams Tin per Liter	Concentrates Grams Tin per Liter
26% NaCl, sat. $PbCl_2$	1.03	0.27
Na_2SO_3 $\frac{M}{10}$	0.27	0.02
$KHSO_4$ $\frac{M}{10}$	0.22	0.05
H_2SO_4 2M sat. Cl_2	0.48	0.04
$NaHSO$ $\frac{M}{1}$ sat. SO_2	0.50	0.09
$NaHSO_3$ $\frac{M}{1}$ NaOH 2M	2.05	0.07
$NaHSO_4$ $\frac{M}{1}$ sat. Cl_2	0.30	0.09
$CuSO_4$ $\frac{M}{2}$	0.50	0.05
Na_2Sx sat.	32.00	0.80
Na_2S sat.	31.36	0.87
H_2SO_4 15%, NaCl 5%	5.41	0.89
H_2SO_4 30%, $FeSO_4$ 30%, NaCl 5%	3.50	0.50

It is interesting to note at this point that the soluble salts of tin are very limited in number. Tin nitrate and tin cyanide do not exist. Only the sulphates, halides, the sulphocyanate, and the chlorate are soluble among its inorganic compounds. The complex thio-stannites and thio-stannates are soluble. The organic salts, the acetates, oxalates, tartrates, and malates, are soluble.

Of the inorganic salts stannous sulphate very readily changes over in the presence of moisture to oxy and stannic salts. Stannic sulphate is very readily hydrolyzed in aqueous solution. The fluorides of tin are quickly affected by moisture, with resultant decomposition. All the stannous halides readily oxidize to the stannic form; in neutral solutions they readily decompose to form cloudy solutions as a result of the formation of oxy salts. The thio-cyanate and chlorate are fairly stable under proper conditions, but they readily hydrolyze in aqueous solution. The organic salts of tin are readily decomposed, with the formation of metastannic acid or oxy salts. No tin salts exist which are as stable as copper sulphate, copper nitrate, or copper chloride. Stannic chloride is a fuming liquid at ordinary temperatures; as $SnCl_4$ $5H_2O$ it is a solid readily affected by moisture and easily hydrolyzed in aqueous solution.

After due consideration of all the methods for analysis of tin, it has been decided that the quickest and most convenient method is that of precipitation with hydrogen sulphide in acid solution. A separation of such metals as copper, bismuth, arsenic, and related metals,

TABLE III.—SULPHATE SOLVENTS

Leaching Solution	SnO_2 Grams Tin per Liter	Concentrates Grams Tin per Liter
$FeSO_4 \cdot 7H_2O$ $\frac{M}{10}$	0.04	0.03
$FeCl_3 \cdot 6H_2O$ $\frac{M}{10}$	0.05	0.04
$Fe_2(SO_4)_3$ $\frac{M}{10}$	0.17	0.25
$MgSO_4$ $\frac{M}{10}$	0.00	0.04
$KHSO_4$ $\frac{M}{10}$	0.22	0.05
H_2SO_4 2M sat. Cl_2	0.48	0.04
$(NH_4)_2SO_4$ $\frac{M}{1}$ sat. Cl_2	0.03	0.03
$MnSO_4$ $\frac{M}{1}$	0.04	0.03
Na_2SO_4 $\frac{M}{5}$ sat. SO_2	0.07	0.03
$NaHSO_4$ $\frac{M}{1}$ sat. SO_2	0.50	0.09
$NaHSO_4$ $\frac{M}{1}$ sat. Cl_2	0.30	0.09
$CuSO_4$	0.50	0.05
H_2SO_4 15%, NaCl 5%	5.41	0.89
H_2SO_4 30%, $FeSO_4$ 30%, NaCl 5%	3.50	0.50
H_2SO_4 30%, NaF 4%	0.38	0.45
H_2SO_4 20%, NaF 4%	0.40	0.42
$FeSO_4(NH_4)_2SO_4 \cdot 6H_2O$ $\frac{M}{20}$ sat. SO_2	0.17	0.20

occurring in the ore by means of sodium sulphide from the tin sulphides, with a reprecipitation of the tin, will be of the same order of accuracy as the solubility determination of the tin compounds. Inasmuch as this whole series of experiments is really only qualitative, the hydrogen sulphide method for tin analysis, with subsequent oxidization of the sulphides to stannic oxide, in which form it will be weighed and calculated, seems entirely satisfactory.

The procedure for the determination of tin in the leaching solutions, resulting from the treatment of stannous oxide, stannic oxide, roasted, ground, and unground ores, was as follows:

The oil-sample bottles in which the materials had been agitated were unstoppered after the bottles had been washed on the outside. Then the solution was filtered

TABLE IV.—CHLORIDE SOLVENTS

Leaching Solution	SnO_2 Grams Tin per Liter	Concentrates Grams Tin per Liter
$FeCl_3 \cdot 6H_2O$ $\frac{M}{10}$	0.05	0.04
NH_4Cl $\frac{M}{1}$	0.01	0.00
$CaCl_2$ $\frac{M}{1}$	0.13	0.14
26% NaCl, sat. $PbCl_2$	1.03	0.27
NaCl $\frac{M}{2}$ sat. Cl_2	0.20	0.12
NH_4Cl $\frac{M}{1}$ sat. SO_2	0.07	0.04
$FeCl_3$ $\frac{M}{1}$ sat. Cl_2	0.18	0.19
NaCl $\frac{M}{2}$ sat. SO_2	0.07	0.03
H_2SO_4 15%, NaCl 5%	5.41	0.89
H_2SO_4 30%, $FeSO_4$ 30 %, NaCl 5%	3.50	0.50

through qualitative filter paper, and 50 c.c., carefully measured with a pipette, was taken for analysis. Solutions were neutralized in those samples which were known to have excessive acidity and, in all cases, brought to concentration equivalent to 2½ c.c. of hydrochloric acid per 100 c.c. of solution. Tin was then precipitated as either the stannous or stannic sulphide, as a result of subjecting the solution to a rapid stream of hydrogen sulphide for fifteen minutes. Hydrogen sulphide was generated in a large McCay generator, using iron sulphide and hydrochloric acid. It was washed through two gas-bubble bottles in series.

The precipitates were allowed to settle (all precipitation was done in clean oil-sample bottles of 4-oz. size) and were then filtered by suction in Gooch crucibles, using acid-washed asbestos as a filtering medium. The crucibles had been previously brought to constant weight by ignition in a small furnace, made from an alundum furnace core, wound with No. 21 B. & S. gage chromel wire. In tests where stannous and stannic oxides had been leached, it was not necessary to treat the precipitates further in order to effect separation of other metals, as mercury, bismuth, copper, cadmium, lead, arsenic, and antimony, which would be precipitated by hydrogen sulphide in hydrochloric acid solution, were all absent. In tests on precipitates from the ore, however, it was necessary to treat the precipitate further in order to remove the above-named metals, which occur in the ore in very small amounts and are precipitated by hydrogen sulphide in acid solution. Completeness of precipitation was tested in all tests by subjecting the filtrate to a rapid stream of hydrogen sulphide gas for at least twenty minutes. Any additional precipitate which was formed was added to the sulphides from this sample by filtration through the same Gooch crucible previously used.

TABLE V.—MISCELLANEOUS SOLVENTS

Leaching Solution	SnO_2 Grams Tin per Liter	Concentrates Grams Tin per Liter
Iron Salts		
$FeCl_3 \cdot 6H_2O$ $\frac{M}{10}$	0.05	0.04
$FeSO_4 \cdot 7H_2O$ $\frac{M}{10}$	0.04	0.03
$Fe_2(SO_4)_3$ $\frac{M}{10}$	0.17	0.25
$FeCl_3$ $\frac{M}{1}$ sat. Cl_2	0.18	0.13
H_2SO_4 30%, $FeSO_4$ 30%, NaCl 5%	3.50	0.50
$FeSO_4(NH_4)_2SO_4 \cdot 6H_2O$ $\frac{M}{20}$ sat. SO_2	0.17	0.20
Ammonium Salts		
NH_4Cl $\frac{M}{1}$ sat. SO_2	0.07	0.04
NH_4Cl $\frac{M}{1}$	0.01	0.00
$(NH_4)_2SO_4$ $\frac{M}{1}$ sat. Cl_2	0.03	0.02
$(NH_4)_2S$ $\frac{M}{1}$	0.31	0.16
Sulphites		
Na_2SO_3 $\frac{M}{10}$	0.27	0.02
$NaHSO_3$ $\frac{M}{1}$	0.10	0.07
$NaHSO_3$ $\frac{M}{1}$ sat. SO_2	0.14	0.07
$NaHSO_3$ $\frac{M}{1}$ NaOH 2M	2.05	0.07
Sulphides		
$(NH_4)_2S$ $\frac{M}{1}$	0.31	0.16
Na_2Sx sat.	32.00	0.80
Na_2S sat.	31.36	0.87

Separation was made in either of two ways. The first method consisted in treating the precipitate with sodium polysulphide, in which the tin sulphides are soluble and the sulphides of mercury, copper, bismuth, lead, and cadmium are insoluble. Antimony was present to the extent of 0.04 per cent in the ore, and arsenic to the extent of 0.01 per cent. Both of these metals as oxides are readily volatilized at the temperature at which the precipitate was ignited. Inasmuch as none of these results are of a high order of accuracy, it was decided that it was not necessary to make a separation of antimony and arsenic from the tin sulphates, which were precipitated from the sodium polysulphide, by neutralization of the solution and restoring the acidity to that in which the original precipitation was made. Copper is present to the extent of 0.036 per cent in the ore and bismuth to the extent of 0.296 per cent. The oxides of both these metals are soluble in hydrochloric acid, whereas the oxide of tin is not. This, then, offers a method of separation of tin oxide from bismuth and copper oxides by treating the ignited residue with hydrochloric acid; the stannic oxide, being insoluble, remains on the filter. This was the second method used for separation of the metals of the same group, in the qualitative scheme, from tin.

The tin sulphides in the Gooch crucibles were ignited (in the cases of solutions resulting from the ores, the other sulphides also being present) at about 800 deg. to stannic oxide, the crucibles were cooled, and the contents treated with concentrated hydrochloric acid by pouring the acid through the crucibles until all contaminations were removed. The crucibles were then re-ignited, brought to constant weight, and the addition in weight from the original weight was considered as stannic oxide, from which the number of grams of tin in the 50 cc. samples was calculated. From this figure the equivalent concentration of tin in grams per liter was computed. The results for the leaching solutions are tabulated in the table included in this report.

This method of analysis was supplemented and replaced wherever possible by the more rapid volumetric determination of tin by iodine titration. Samples were taken as before and stannic tin was reduced to stannous by the use of pure aluminum foil. The precipitated tin was redissolved in hydrochloric acid. The titration with iodine was made in an atmosphere of carbon dioxide according to the standard method of analysis.

Results obtained with the various leaching solutions are tabulated in the attached data sheets. The solubility of the leach constituents is given for reference. Stannous oxide, previously known to be soluble in various reagents, is included in the data, for comparison.

Discussion of Leaching Results

As the investigation of the solubility of tin concentrates had as its aim the development of a leaching process, only such chemicals were used as are available in commercial quantities and at reasonable prices.

A glance over the table of results shows that in no case was there marked solubility in a commercial sense. Results seem to hold out little hope for the development of a direct leaching process either of tin concentrates, cassiterite, or tin ore. The results were studied and reassembled in various ways in an attempt to determine whether any particular radicals were more active in causing solution than were others.

In practically all cases the solubility of the concentrates was the same, irrespective of their previous treatment. It did not make any difference in the solubility whether the concentrates were treated as received, or after roasting, or after fine grinding and screening.

In some cases, notably those of M/10 ferric sulphate, M/1 ammonium chloride, and M/1 potassium cyanide, roasting the concentrates decreased the tin solubility.

In a number of cases the solubility of the chemical, stannic oxide, is very much higher than the stannic oxide of the tin concentrates. Commercial stannic oxide is produced either by furnace oxidation of tin metal or by chemical oxidation (such as through the use of nitric acid) of tin metal or tin salts. The cases in which there was a marked difference between the solubility of stannic oxide and the concentrates are tabulated.

It seems evident that the stannic oxide produced by chemical processes is a material with quite different properties from the stannic oxide of cassiterite. The stannic oxide of cassiterite is markedly crystalline, the crystals being of comparatively large size. Cassiterite occurs in igneous rocks and was formed at 1,132 deg. C., or above the fusion point. The chemical stannic oxide is an amorphous material, non-crystalline in its nature. It is produced far below the fusion point. The stannic oxide used in these experiments was roasted but not fused.

From the results tabulated it can be seen that the sulphate ion causes no great amount of solubility. The effect of chlorides and anofluorides as well as greater acidity of the leaching solution is shown in the increased solubility. The examples of this are ferric sulphate $\frac{M}{10}$ (61) sulphuric acid 15 per cent, sodium chloride 5 per cent (391), sulphuric acid 30 per cent, ferrous sulphate 30 per cent, sodium chloride 5 per cent (401) and the similar series Nos. 411, 421, and 431.

The chlorides cause an increase in the solubility of stannic oxide and of the concentrates. In those cases where the ammonium ion was present, the solubility decreased. The effect of sulphur dioxide and chlorine may be seen in the case of NaCl $\frac{M}{2}$ saturated with Cl_2 and the same solution with SO_2 substituted for the dissolved chlorine. Solubility of the concentrates decreases markedly. The chlorides have, of all the compounds studied, the greatest solubility effect on the concentrates.

Iron salts per se do not seem to dissolve cassiterite. The combination of relatively strong acidity, an iron salt, and a chloride gave the best solubility of those iron salts tested. Ammonium salts do not have appreciable solvent action on Bolivian concentrates.

From the results obtained and over the range of experiments recorded, the possibilities of developing a leaching process for tin ore analogous to the leaching methods used for copper do not exist at present. Cassiterite has been shown to be very insoluble from a commercial point of view.

F. R. Koeberlein recently published a paper entitled "Geologic Features of Bolivia's Tin Bearing Veins" (*Enginering and Mining Journal-Press,* Vol. 121, p. 636). He describes some deposits of cassiterite in which, according to field evidence, it appears that much secondary cassiterite was deposited under conditions resembling those found in the zone of secondary sulphide enrichment. Facts observed in the field seem to uphold the conclusion that the solution of cassiterite in the tin veins and redeposition at lower levels, far from being a scientific curiosity, is a natural process of the most vital economic importance in Bolivia.

TABLE VI.—MISCELLANEOUS SOLVENTS

Leaching Solution	SnO_2 Grams Tin per Liter	Concentrates Grams Tin per Liter
Metallic Ions other than Fe, Na and NH_4		
$Al(NO_3)_3 \cdot 9H_2O$ $\frac{M}{10}$	0.00	0.00
$MgSO_4$ $\frac{M}{10}$	0.00	0.04
$KHSO_4$ $\frac{M}{10}$	0.22	0.05
$SnCl_2$ $\frac{M}{1}$	0.00	0.00
$CaCl_2$ $\frac{M}{1}$	0.13	0.14
KCN $\frac{M}{1}$	0.05	0.90
$MnSO_4$ $\frac{M}{1}$	0.04	0.03
$CuSO_4$ $\frac{M}{2}$	0.50	0.05
26% NaCl—sat. $PbCl_2$	1.03	0.27
Halides other than Cl		
NaF $\frac{M}{2}$	0.25	0.13
I_2 sat.	0.06	0.08
Br_2 sat.	0.08	0.10
H_2SO_4 30%, NaF 4%	0.38	0.45
H_2SO_4 20%, NaF 4%	0.40	0.42
H_2SiF_6—20%	0.47	0.42
Organic Acids		
$(COOH)_2$ $\frac{M}{10}$	0.10	0.10
HCOOH—20%	0.02	0.04
$HC_2H_3O_2$—2M sat. Cl_2	0.04	0.08
HCOOH—10%	0.09	0.09

Geologically the solubilities of cassiterite observed in our work are appreciable. The solubilities observed seem to support the solution theory of enrichment. This theory supposes that there is solution of cassiterite in the upper parts of the vein; downward percolation; and redeposition of tin oxide at lower levels. That there are objections to this theory is obvious when placer cassiterite deposits are considered. This mineral is carried many miles from its source, in the finest state of comminution, subject to attack by waters of various and varying alkalinity and activity. Cassiterite is usually considered to be extremely inert and insoluble. Chemically this is true; geologically it is appreciably soluble.

Koeberlein makes the suggestion that the oxidation of associated pyrite has a reducing action on stannic oxide, facilitating its solution in the form of compounds of lower valence. Our own work shows that in acid solutions sulphur dioxide oxidizes stannous oxide; it would not, therefore, reduce stannic oxide, and the suggested explanation must be modified. Elsewhere the presence of copper minerals is cited as having a possible effect; the low solubility of Bolivian concentrates in copper solutions does not seem to support this statement.

On the whole, the values found for the solubility of tin compounds from Bolivian concentrates, may bulk large from a strictly geologic viewpoint.

Reprecipitation of tin salts may occur easily, as a consideration of the properties of the soluble tin salts will show. The halides of tin are readily hydrolyzed, the decomposition proceeding more rapidly with increase of temperature. These salts in their lower valence forms are readily oxidized. The other soluble tin salts easily decompose. None are as stable as the copper salts.

Experiments carried on in attempted leaching of cassiterite by a large number of different reagents at room temperature showed that:

1—Cassiterite is very insoluble.
2—No cheap chemical compound has any appreciable effect on cassiterite.
3—No cheap chemical compound was found which, from the results obtained, held out the opportunity or possibility of a commercial leaching process.

Further experimental work was carried on at higher temperatures with aqueous solutions of the mineral acids at various concentrations alone, and with various salt additions. The salt additions were made to the concentrates, the acids were then poured on the concentrates, and the mass was well stirred.

This work is reported in brief form, because of the negative results obtained. In all cases, five grams of ore were digested with 500 cc. of the solution in question at 100 deg. C. for four hours, except where otherwise noted. In many cases the concentrates were disintegrated and iron was leached out. The concentrates had been previously roasted. They were ground in a ball mill to pass a 24-mesh screen. After digestion, the solution was cooled, filtered, and tested qualitatively for tin. The method used was to first reduce with zinc and then test 50 cc. of the solution with 10 cc. of a 1 per cent solution of mercuric chloride. If a definite blackening of the white mercurous chloride precipitate occurred, the test was called positive and the tin content of the solution was thus shown to be greater than 0.8 gm. tin per liter.

Using the above-described test, no positive results were obtained with the following solutions:

1A—Concentrated sulphuric acid, sp. g. 1.836. In testing for tin, this solution was diluted to 25 per cent, then tested and calculated back to its original concentration. No hydrolysis of tin salts was observed. Tests negative. Determinations made at 100, 120, 140, and 180 deg. C.
2A—50 per cent sulphuric acid, diluted for testing as 1A
2B—2A plus 2 per cent NaF.
2C—2A plus 2 per cent NaCl.
2D—2A plus 5 per cent NaCl.
2E—2A plus 2 per cent $NaNO_3$.
All tests negative. No precipitate with $HgCl_2$.
3A—25 per cent sulphuric acid.
3B—3A plus 2 per cent NaF.
3C—3A plus 2 per cent NaCl.
3D—3A plus 5 per cent NaCl.
3E—3A plus 2 per cent $NaNO_3$.
3F—3A plus 5 per cent $(Fe)_2(SO_4)_3$.
All tests negative.
4A—50 per cent hydrofluoric acid. Copper dish used. Time of digestion, one hour. Temperature 75 deg. C. Tests negative.
4B—4A plus 5 per cent NaCl. Glass beaker used. Temperature 75 deg. C. Time of digestion, one hour. Tests negative.
4C—4A plus 10 per cent Na_2SO_4. Temperature 75 deg. C. Tests negative.
4D—4A plus 2 per cent $NaNO_3$. Temperature 75 deg. C. Tests negative.
5A—Concentrated hydrochloric acid (38 per cent). Temperature 100 deg. C. Time, four hours.
5B—5A plus 2 per cent $NaNO_3$.
5C—5A plus 5 per cent NaF.
5D—5A plus 5 per cent NaCl.
5E—5A plus 2 per cent Na_2SO_4.
All tests negative.
6A—30 per cent NaOH.
6B—6A plus 2 per cent NaCl.
6C—6A plus 2 per cent NaF.
6D—6A plus 2 per cent $NaNO_3$.
6E—6A plus 5 per cent NaCl.
6F—6A plus 5 per cent Na_2SO_4.
All tests negative as defined above.
7A—20 per cent solution of ferric sulphate—temperature 100 deg. C. Time four hours. Tests negative.

These results do not offer much encouragement for the immediate development of a commercial leaching process. The possibility of the discovery of a solvent of stannic oxide is not at all hopeless. We feel that further investigation appears well worth while; and such investigation is going forward.

Progress in the Metallurgy of Zinc in England

THE International Metal Service, of London, in a recent communication to the American Zinc Institute, gave the following information regarding the Ashcroft process, known as "New Metallurgy":

A unit with a capacity of five tons a day has been erected at Avonmouth, in Great Britain, under the auspices of the leading zinc interests in the British Empire, and long runs will be made and results checked beyond any shadow of doubt before anything in the way of detailed working results is made public. The process consists in subjecting raw ores of sulphide of zinc and lead to a blast of gas in a fluid medium of fused zinc and lead and other metal chlorides (resulting from the reaction) in a converter of special form. Sulphur is given off and condensed and all the metals go to fluid chlorides at a temperature of reaction of 600 deg. C. In a second vessel the melt is treated with zinc, and iron and lead—with silver and copper if present—are thrown out in metallic form. The heavy alloy of these metals is easily separated from the pure zinc chloride, which now passes to the electrolyzers, the lead, iron, silver, and copper being amenable to complete and economic recoveries of lead, silver, and copper by smelting.

In the electrolyzers, pure zinc (equivalent to that contained in the ore plus that used to precipitate lead and iron) and chlorine gas are recovered quantitatively. The chlorine passes to the converters for use again cyclically and the zinc to market—while an equivalent amount for the iron and lead recovered there goes to the precipitators.

Two peculiarities claimed for this process are (1) its very complete extractions of all metals and of sulphur, over-all recoveries being stated at 98 to 99 per cent and (2) the feature that no fuel is used, except for minor purposes, all the principal reactions being exothermic, so that the converters heat themselves and likewise the precipitators, while the necessary heat for the electrolyzers is supplied by the electric current. The major item of cost in the whole treatment is for electricity, and consumption of this is stated to be low.

Such are the claims for the Ashcroft process as gathered from its inventor, and it is obvious that if they are substantiated commercially in the small trial unit, a decided step onward will have been achieved in metallurgical progress.

The ten-ton trial unit of the Coley process, at Birmingham, England, is still engaged in tests.

As regards the Elmore chemical method of treatment owned by the Chemical & Metallurgical Corporation, results should be available some time during the current year from the plant erected in England.

DISCUSSION

Defining Engineering

THE EDITOR:

Sir—*Engineering and Mining Journal* of Nov. 5, 1927, published certain excerpts from the Bulletin of the Mining and Metallurgical Society of America on the subject of "What Is Engineering?" This discussion is both timely and interesting. The question is of major importance from professional, educational, and public standpoints, and not merely an academic one, as might appear at first thought.

It is unlikely that general agreement can be reached on the exact wording of any concise definition, but it ought to be possible to formulate the fundamentals that constitute engineering, as distinguished from those that are irrelevant. With this thought in mind it has occurred to me that perhaps the views of members of other engineering societies might be of service, at least to clarify some of the points already brought out in the discussion. As a constructive suggestion the following is offered:

Engineering is the art of applying Science to Industry.

In order to comprehend a brief statement like this, it is essential that the meaning of each word be fully weighed. *Science,* therefore, is here defined as "systematized knowledge of the truths and laws of the universe, especially as demonstrated by experiment and observation." *Industry* is used in the broad sense as "the definite beneficial result of constructive human effort, applied to the utilization of the materials, products, and forces of nature." *Art* is defined as "any highly skillful method devised by man to accomplish a definite achievement."

Paraphrasing the above definition: engineering consists in devising skillful methods of applying a systematized knowledge of the laws and truths of the universe to the achievement, through human effort, of definite beneficial results, from the utilization of the materials, products, or forces of nature. Thus described, engineering has as its fundamental requirement the devising of ways and means of directing scientific knowledge into channels best suited for the utilization by man of materials and forces.

It does not appear, however, that the application of scientific *methods* alone is sufficient to constitute engineering. There must be direct use of mathematical, physical, chemical, or other scientific *knowledge.* Methods similar to those in use by scientists are of great economic value, and have many important applications in industry apart from engineering. Furthermore, the manual operations founded on the application of scientific knowledge are not engineering in any sense, but are functions of industry. It is the *design,* the skillful solution of the problem, through the use of scientific *knowledge,* that is engineering.

It should be remembered that engineering is distinctly human in its objectives. Pure science deals only with the immutable laws and truths of the universe. When methods and designs are devised for applying scientific knowledge to the wellbeing of mankind, the result is the Art of Engineering. Fundamentally, engineering is *creative* and *economic,* and generally it is commercial in its developments, but such attributes only indicate its humanity.

In support of the definition of engineering as here suggested it should be recalled that most of the great engineering societies of the world require, as a prerequisite for membership, the ability to design. Engineering design consists in devising means, ways, and methods for accomplishing certain material results by the use of mathematical and other scientific knowledge. This is equally true of the design for a bridge, a highway, a machine, a power plant, or a metallurgical process. There must be scientific knowledge and there must be a plan for applying that knowledge to the manipulation of materials and forces to some useful end. The *plan* is engineering, and he who makes it is engaged in the practice of engineering.

A frequent cause of misunderstanding as to what constitutes engineering arises from the varied occupations in which engineers are engaged. Few practice engineering continuously, and many not at all. Engineering training is a most excellent preparation for many activities of life, and the majority of engineers are executives, industrial managers, salesmen, teachers, scientists, and the like, or are serving in junior situations leading to such vocations. It must be remembered that many of the things that men of engineering training commonly do for a livelihood are not in any sense engineering, although they may be useful and profitable occupations.

San Francisco. M. H. GERRY, JR.

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Concerning Rasorite

THE EDITOR:

Sir—Interest is added to your editorial "The Vicissitudes of the Borax Miner" in the issue of Nov. 12, when one knows the history of the new discovery of rasorite in the deposit mentioned near Kramer, Calif. This deposit is underneath an alluvial flat in the Mohave Desert; the shallowest deposits are over a hundred feet below the surface and there is absolutely nothing on the surface to suggest the occurrence of any mineral of value in the locality.

About 1913, a Los Angeles doctor and his wife filed on 480 acres of land with the expectation of reclaiming it by irrigation, the water to be obtained from wells. Had the doctor secured competent advice on the subject he would have learned that there was no chance of reclaiming ten acres from any local water supply, to say nothing of the 480 acres in the two filings. But, not knowing any better, he proceeded to have a well drilled; and, in the course of the drilling, some white material was brought up. Analysis showed this to be borax,

so the doctor very sensibly sought legal advice and took the proper steps to secure the land under the mining laws.

Many claims were located, most of which were acquired by the United States Borax Company, a subsidiary of the Pacific Coast Borax Company, and extensive drilling was carried on. This drilling demonstrated the existence of a large deposit of colemanite and ulexite, occurring chiefly as nodules of varying size in a clay matrix locally referred to as "blue shale." Although the deposit had value, there was nothing sensational about it, and it was regarded as a reserve to be built up for future operations—until the remarkable discovery of rasorite in 1926. Rasorite is the purest borax ore yet discovered, native borax, of course, excepted, and no one can predict the size of this deposit. There is little doubt that sufficient ore has already been developed to supply the market for the remainder of this century.

The Death Valley deposits are in an isolated region. A standard-gage railroad was built into their general locality and then a narrow-gage railroad involving heavy construction was built to connect the standard-gage with the mine. The Kramer deposit is within four miles of the main line of the Santa Fé, with only an alluvial flat to cross. A spur track was built with almost no grading. The distance from the new mine to the company's refinery at tidewater is about 150 miles, as against about twice that distance over which the Death Valley deposits must be shipped.

I would not hazard a guess as to the investment at Death Valley, but it is large and one may doubt if this or any succeeding generation will see further activity there, all because a German doctor from Los Angeles didn't know any better than to attempt to do the impossible!

It reminds one of Bret Harte's poem "Dow's Flat." Dow was pursued by bad luck. Everything he attempted failed, until finally he struck it rich. But even then his luck ran true to form, because he was sinking a well trying to find water when he hit the quartz ledge that made him rich, and he never did find the water.

San Francisco, Calif. LEROY A. PALMER.

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Banditry in Mexico

THE EDITOR:

Sir—In the issue of Dec. 10 under Personal Notes there appeared an item as follows:

"H. W. Thompson, American manager of a mine at Copala, State of Guerrero, Mexico, was kidnapped by bandits recently and held until a ransom of 5,000 pesos had been paid."

After reading your editorial in the issue of Dec. 24 on more and better "Personals" I thought you might be interested in hearing the facts of my recent experience.

I was kidnapped from the Batel mine, in the Santa Lucia district, State of Sinaloa, Mexico, on Nov. 25, 1927, by a gang of 40 bandits led by the self-styled Colonel Bocardo, who is an itinerant bandit, having previously operated in the states of Jalisco and Nayarit. I was held for 5,000 pesos ransom, and sent a letter to P. H. Crawford, of Copala, Sinaloa, Mexico, for this amount. A messenger was dispatched with a fraction of this amount to do business with the bandits. He was overtaken by government troops that were in the mountains chasing the bandits, and the money was not delivered. When the government heard of my capture it caused the arrest of about twenty men, women, and children—relatives of the bandits—and told them that if anything happened to me they would all be shot. This word evidently reached the bandits, as I was released after a rather unpleasant week in their company. My only loss was in personal effects to the value of about $500 gold. THOS. W. THOMPSON.

Copala, Sinaloa, Mexico.

* * * *

Are Joplin Zinc Stocks Excessive?

THE EDITOR:

Sir—There is no serious overproduction of zinc ore nor of slab zinc. It need not have assumed even an aspect of seriousness but for erroneous wording of statistics handed out for publication.

Before publicity was a dominant factor, this district had twice as much ore in the bins at one time as it has today, yet that period was passed with no outcry of overproduction. Prices sagged, as they must under such conditions, but the district recovered its equilibrium with a minimum of loss.

During several recent years statistics have been given publicity, recurring week after week until midyear, 1927, using the word "surplus" in reference to reserve stocks or ore. The word "surplus" is a danger signal in industry and in trade. Hanging out this signal has had no slight bearing upon the current depression in the consumption of slab zinc.

In recent months the weekly reports state that there is "stock on hand." This does not convey such a strong signal of distress, yet it can be so construed. Stock on hand suggests a purchasable quantity and the larger such quantity the greater the pressure to sell. But during all this time, and today, more than half the ore in bins is not purchasable at call, and should be reported accurately as *reserve stock* or not be reported.

In reserve the ore is not subject to forced sale—is not a marketable product in fact—and though it cannot fail to create some slight ill effect, yet given correct classification it must of necessity remove a large degree of the false impression that has been broadcast from this district.

Consumers of slab zinc, and consumers of all the products of slab zinc, have been led to believe that there are thousands of tons of zinc ore in the bins here that can be bought at any price. Stock on hand means just that. It indicates that all ore in bins is a marketable product. With more than half the stock in bins held in reserve, and a large portion of the balance sold, the marketable tonnage is ever negligible.

There is today around 50,000 tons of visible ore in the Tri-State district. More than 25,000 tons of this is held in reserve—is not for sale. About 15,000 tons of the remainder is under contract for shipment, leaving a net marketable balance of barely 10,000 tons of zinc concentrates.

How can this be construed as a dangerous situation? Even an assumption of seriousness is allayed by taking into consideration the possibility of a protracted period of cold that could severely cripple production and stop shipments.

World consumption seems to have consistently absorbed world production of slab zinc, according to published reports, with but a modicum increase of stock. There is plenty of evidence that this trifling increase will be quickly wiped out, that demand from consumers who have bought short for several months will steadily

reduce other stock, and this forces the suggestion that any demand from an unexpected quarter could create a shortage that would send prices soaring upward within the first ninety days of the new year. Estimating from past years, the stocks now known would scarcely supply an aroused demand for one month. Slab zinc stocks at the year end have been larger in preceding years and found ready assimilation.

Market depression is a theory rather than a fact, brought about by hand-to-mouth buying and the assumption that marketable stocks are excessive. This is largely based on the statements, reiterated week after week in trade papers, that there is a dangerous surplus of stocks of zinc ore in the Tri-State district. When a thorough analysis discloses that there is no marketable stock in this district and that the bulk of bin tonnage is held in reserve by financially strong producers, who can continue to hold indefinitely, the year-end situation will assume an entirely different aspect. When consumers of slab zinc awake to a realization that the tonnage of marketable zinc ore in this district is so small that any effort to increase purchases would speedily force advancing prices it will be but a few weeks until metal and ore stocks are found inadequate.

Taking into consideration that at this season of the year there is a forced restriction of zinc output in Wisconsin and in the zinc-producing areas of the northwestern region of the United States and British Columbia, it will not be hard to understand that the small stock of marketable zinc ore in the Tri-State district is the key to the situation, and that the holders of reserve stocks of zinc ore occupy a position that could be exerted in control of ore and metal markets over the next three months.

JESSE A. ZOOK.

Joplin, Mo.

* * * *

How Much of the Vein Is Ore?

THE EDITOR:

Sir—The problem of "How Much of the Vein Is Ore?" as discussed by E. G. Lawford in your issue of Jan. 14, 1928, is far more complex than the formula he uses would imply. This is especially true of narrow orebodies of high-grade ore. Instead of but two classes of costs—those independent of and those varying with the tonnage—there are at least six classes of costs, each of which requires consideration in determining the optimum grade of ore to be mined.

Representative cost items are given in an accompanying table. The notes below this table show that many types of cost are erratic in their action, depending on such conditions as the range of stoping widths and the capacity or suitability of the mine equipment to meet the increased load that will follow the inclusion of lower-grade ore. Other mining costs will fit into one of these groups or can be divided between two of them. Mr. Lawford in his formula assumes that the recoverable value per ton can easily be found, probably by subtracting the current tailing assay from the head assay. This overlooks the generality that as the grade falls off the recovery also drops, if the treatment method is unchanged. A change in the treatment method to make the recovery the same would of course, naturally result in an increase of the treatment cost.

The question of where to place the line between ore and waste in a vein with commercial boundaries is a difficult one. It can be solved, however, only by making an estimate of the profit obtainable from the tonnage and recovery at different stoping widths and ore grades, and then mining the width that gives the maximum profit. Such a study by any mine is also useful for its bearing on the determination of the best scale of operations, taking into consideration the capital and other charges that must be met for each output.

In the latter part of Mr. Lawford's article, in his discussion of Class 1 and Class 2 ore, it should be noted that in narrow veins much Class 2 ore is broken in order to get the Class 1 ore out cheaply. Such ore should be considered and handled in the same way as development (Class 3) ore, if its mining were really justified.

ROBERT K. WARNER.

Yale University, New Haven, Conn.

Types of Mining Costs

Group or Symbol	Items	Effect of Raising Output by Increasing Stoping Width	
		Cost Per Ton	Cost Per Day
c	Superintendence	Decreased	Unchanged (c)
d	Invested capital charge	Decreased	Doubtful (d)
e	Stoping cost	Doubtful (e)	Increased (e)
f	Tramming cost	Unchanged (f)	Varies with tonnage
g	Support of workings	Doubtful (g)	Increased (g)
h	Metallurgical losses	Doubtful (h)	Increased

(c) Within usual limits. (d) Unchanged unless added tonnage requires increased equipment. (e) Cost per ton will decrease until optimum stoping width is reached. From then on it should be constant. Unless increased width reduces cost per ton the cost per day will vary directly as the tonnage. (f) Unless of course increased tonnage to be trammed justified change in tramming method, in which case item (d) will also be affected. (g) Frequently the cost of support, if any is needed, will increase at a more rapid rate than the size of the opening to be supported. (h) Addition of low-grade material dilutes values and usually increases losses in mill or smelter. This is particularly marked when the increased tonnage overloads the treatment plant.

* * * *

Flotation Nomenclature

THE EDITOR:

Sir—In your issue of Dec. 3, 1927, you invite comment on your proposals for flotation nomenclature, which originally, and as given in your issue of April 3, 1926, were much as follows: That the term "selective" be used where two or more marketable products were produced, and that "differential" be used where one sulphide is floated while another is made to sink with the stony material.

Consonant with that nomenclature, A. B. Parsons wrote in *Mining Journal* of Oct. 8, 1927, when describing the operations of the Britannia mill, British Columbia, "Until recently the process has been one of 'differential' flotation; now I presume it should be classed as 'selective,' for the reason that a market has been found for the pyrite, and a separate concentrate is made."

Against the acceptance of those proposals as well as of your present suggestion that the term "selective" should be used generally to the exclusion of "differential," this much may be said. There is a wide use of the term "differential" to describe all flotation practice where differences of floatability between sulphides are by purposeful procedure made use of in separating them from one another, either to the greater cleanliness of a single concentrate, copper sulphides from pyrite for instance; or to the obtaining of separate concentrates, lead and zinc concentrates for instance. The only other description of flotation is then "collective," or "bulk" flotation, where all the metalliferous sulphides present are floated together, the resultant concentrate, according to the particular case, being either clean enough in one valuable sulphide, or containing so much of others as to warrant subjection to differential flotation for separate recoveries.

For instance, the U. S. Bureau of Mines, in Bulletin

205, set out a nomenclature where "differential flotation" is defined as "the flotation of one flotative mineral in the presence of another ordinarily flotative"; and no mention is made of "selective." Fahrenwald, Tucker, Head, and many others have published valuable researches on "differential flotation," giving to that term the same wide significance. H. A. Pearse, metallurgist of the Britannia mill, when describing the operations of that mill in a paper published in the Bulletin of the Canadian Institute of Mining and Metallurgy, November, 1927, used the term "differential flotation" to cover the operations, irrespective of whether the mill was making a separate flotation of the pyrite, or throwing the pyrite into the tailing. R. W. Diamond, describing the separate recovery of lead and zinc concentrates at the Sullivan mine, in British Columbia, in Technical Paper No. 9, of the A.I.M.E., uses the term "differential flotation" throughout, and to the exclusion of "selective." Taggart in his "Hand-book of Ore Dressing" uses "differential" and makes no use of "selective"; Truscott in his textbook equally uses "differential" to the exclusion of "selective."

In addition, the term "differential" is appropriate and expressive. As you, sir, remark, "it may be said that differential implies a greater degree of nice discrimination that "selective," and that, as the separation of two sulphides is based on a critical adjustment of reagents, manipulation, and conditions, "differential" is the better term. It certainly made its appearance with advance in knowledge of flotation phenomena and with scientific study of these phenomena. Its appropriateness lies in its titular emphasis on the minuteness of the differences that have to be reckoned with. Admittedly all flotation processes are selective. But in separating sulphide from sulphide we do not merely select, we seek to employ a calculus of selection, and thereby to differentiate between one sulphide and another.

Royal School of Mines, London. S. J. TRUSCOTT.

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As Between Two Cities

THE EDITOR:

Sir—On page 1042 of your issue of Dec. 31, 1927, it is reported that, "The company mentioned had a crew ready to sail from Spokane the first of June, but the date of departure of the steamer was repeatedly postponed."

As the company was operating in Alaska, we in Seattle, and I guess those in Spokane, would like to have you give the route taken by that boat when it did sail from Spokane to Alaska. C. E. BOGARDUS.

Seattle, Wash.

[Apologies are due and are hereby tendered to Seattle for the inadvertent reference to Spokane.—EDITOR.]

* * * *

Olfactory Prospecting

THE EDITOR:

Sir—Those fellows with doodle bugs and sensitive stomachs are pretty good, but they ain't heard nothin' yet! Mine's a true story, too. Up at Ouray, in the old Barstow, where the glittering yellow stuff comes in unexpected small bunches, Johnson is the best specimen-hound ever on the job and can always tell when to expect specimens in the stope. Coaxed for years, he has finally told his secret—he can tell *by the smell of the stope!* C. R. WILFLEY.

Denver.

By the Way

Big Questions for Geologists

AT A RECENT CONVENTION of the American Association for the Advancement of Science, Dr. George H. Ashley, State Geologist of Pennsylvania, deprecated random guessing about the age of the earth, according to a report in the New York *Times*.

"When one of us declares our giant reptiles were here 6,000,000 years ago and another says 60,000,000 years ago, what is the world at large to think of us?" Dr. Ashley asked. He also wondered what is the future of geology, now that it is faced with stupendous problems and a general lack of interest in it as a science. It is now breaking away from its old moorings and must be prepared to answer such questions as, "Do the continents float? Did Mesozoic times begin 25,000,000 or 250,000,000 years ago? How came our mountains to be? Is there likely to be another ice age, a state-wide lava flow, a continental flooding, such as often occurred in the past?" All of these problems are being approached from new angles. "The very foundations of the deep are being stirred."

* * * *

The Imaginative Statistician

"UTAH'S non-ferrous metal production of record to date would be sufficient to lay a pavement of copper, lead, and zinc—mixed—14 ft. wide and 1 in. thick from Salt Lake City to Washington, with a solid silver milepost 2 ft. square and 6 ft. high at the end of every mile and a solid gold guidepost 6 in. square and 6 ft. high at the end of every tenth mile," said A. G. Mackenzie, of Salt Lake City, at the Mining Congress convention in Washington in December. By inclusion of the gold and silver in the pavement itself the width could be increased 2 in., which would be of advantage to those that meet one-arm drivers at night. Such a pavement would cost only $601,762.42 a mile, which is not incomparable with the cost of other roads actually constructed in many places. And this would be a versatile, as well as a durable, pavement. In case of war we could shoot it at the enemy and lend the mileposts and guideposts to our allies; but in such a contingency we should have an understanding with the Secretary of the Treasury and his successors.

"This metal would be sufficient to erect eight and one-half monuments, all solid and rectangular, of the same base and altitude as the Washington monument here. Or it would be sufficient to provide two 90-lb. railroad rails around the earth at the equator, with a branch line to Salt Lake City and 577 miles of sidetrack.

"The copper produced in Utah would make sufficient No. 1 B. and S. wire to reach from the earth to the moon ten and two-tenths times, if the moon is where the astronomers say it is. If not, this statement should be amended. The lead production is equal to more than twice the total displacement of all the fighting vessels of the U. S. Navy. And the silver, converted into the form we believe it ought to have, would be sufficient to lay a path of silver dollars 9 in. wide from Salt Lake City to New York, via Washington, with enough left over to lay a path on both sides of Broadway and a crosstown path at Forty-second Street. We sometimes think the industry in Utah has spent about the equivalent of that path on that identical route since the intrusion of surtaxes, depletion, and other invaders of what we now know used to be a happy life."

Consultation

What Are "Naval Stores"?

A correspondent requests information as to the meaning of the term "naval stores." The Hercules Powder Co. has kindly supplied this, as follows:

"The term 'naval stores' originally was applied to miscellaneous ship supplies. It was used in England during the sixteenth century to include spars, cordage, pitch, tar, turpentine, and other ship supplies. As the products of the pine oleoresin included rosin, turpentine, tar, and pitch and were long considered principally supplies for wooden ships, the use of the term 'naval stores' subsequently was limited to products of pine oleoresin, commonly known as 'gum.'

"The present use of the term 'naval stores' therefore is applied only to rosin, turpentine, tar, and pitch produced from pine oleoresin and otherwise referred to as 'pine products.' As wooden ships were succeeded soon after our Civil War by metal ships and the use of these materials for ships then became small, and their use as raw materials for manufacturing then became large, the term has since that time been and still is a misnomer. However, its long use as applied to pine products is the justification for its continued use. Such use was legalized by the passage of the United States Naval Stores Act which was approved March 3, 1923, and became effective on March 1, 1924. Said act includes:

"'That when used in this Act "Naval Stores" means spirits of turpentine and rosin.'

"For further information regarding the proper use and meaning of said term I refer you to Dr. F. P. Veitch, Chemistry Bureau, U. S. Department of Agriculture, Washington, who directs the federal operations under the Naval Stores Act."

* * * *

What Foundations Are Best for Drill Sharpeners?

"I would like to know if any of your readers are accustomed to setting their drill sharpeners on concrete foundations. Certain companies recommend it; others do not. You will doubtless remember the days when we used to erect our stamp mills on timber foundations, even shooting out solid rock to make the necessary room. Early manufacturers of tube mills used to insist that the bearings be mounted on wooden pillow blocks. We all got over this idea, and I am not sure whether the manufacturers of sharpeners who want timber foundations are not still in error."

In reply to the above query, which appeared in our issue of Sept. 3, 1927, a prominent manufacturer writes as follows:

"First we wish to point out that the cases cited are in no way parallel to that of the rock-drill sharpener.

"In the case of the stamp mill, the stamps drop a short distance by gravity only. They therefore acquire but little velocity and are invariably cushioned by yielding material on which they strike, so that a metal-to-metal blow does not occur. If the manager will run his stamp mill empty, dropping on the anvil block, it will require but a short time to convince him that a wooden cushion would be a great saving to the stamp-mill structure.

"In the case of the tube mill we have a very heavy rotating structure and a comparatively light moving mass of particles, none of which at any time acquires any great velocity and, therefore, the impact they produce on the tube of the mill and thence on the bearing is not severe. These cases do not prove the point made by the questioner.

"The devices which most nearly parallel the conditions under which a drill-sharpening machine operates are the blacksmith's anvil and the steam hammer. Anvils are always mounted on wooden supports. Blacksmiths have found that unless they are so mounted they are what is called "dead" and the horns and other projecting end of the anvil are soon crystalized and broken off.

"Builders of steam hammers invariably require that the anvil block especially, and usually the rest of the construction, be mounted on wooden foundations. This has been found necessary by experience and is invariably followed as a matter of safety to the structure of the machine.

"With respect to a certain drill-sharpening machine the following facts are significant: The sharpener consists of a stationary and a moving part. The moving part weighs 850 lb. It is propelled downward with a force of 25,000 ft.-lb., acquiring a velocity of 22 ft. per second. At the end of the stroke this represents a force of 23,000,000 ft.-lb. In order to absorb this force through a distance of $\frac{1}{8}$ in. (about the distance the stationary part moves on wood foundation) requires a mean resistance of 750,000 lb. when the sharpener is being operated under ordinary air pressures. Now, should we place this sharpener on heavy concrete foundation so as to reduce the yielding distance to $\frac{1}{16}$ in. the mean resistance necessary to absorb the above-mentioned energy would be 1,500,000 lb. The difference, or 750,000 lb., must, therefore, be absorbed in the stationary structure by molecular movement, tending to crystalize the material if it does not break it at once.

"These considerations we trust will make it apparent why the manufacturer of this machine at least insists on an elastic foundation. It may be stated, further, that such bases as have been returned broken show unmistakable evidence of having been on either stone or concrete foundations."

* * * *

Hyposulphite Leaching and Stamp Mills

"Will you please give me the name of the latest and best book on the lixiviation of silver ores with hyposulphite of sodium? Also, I have never found in your advertisements the name of a firm that manufactures steam stamps such as are used at the Michigan copper mines. Can you give me an address?"

No extended discussion of hyposulphite (or, more properly, thiosulphate) leaching of silver ores has appeared in book form in this country since O. Hofmann's "Hydrometallurgy of Silver," which was published in 1907 and is now out of print. This book contains a chapter on this subject. Hofmann was instrumental in developing the process in the closing quarter of the last century, but most, if not all, of the plants in the United States that were using it closed down about 35 years ago, and its present application in Mexico and South America is limited. Lixiviation with sodium thiosulphate followed chloridizing roasting; in more recent work, such as that done by the Tintic Standard, a solution of common salt, acidified with sulphuric acid, was used. A chapter on "Chlorine Metallurgical Processes," by Stuart Croasdale, appears in Vol. 2 of Liddell's "Handbook of Non-ferrous Metallurgy" (McGraw-Hill Book Company, New York City, two volumes, $12), and contains the most up-to-date summarized information available on this general subject.

Powerful steam pumps are used at the Michigan copper mines, where they have proved their efficiency, but have never been adopted to any appreciable extent elsewhere. A comparison of their efficiency with other modern crushing machinery would be interesting; probably they would be found applicable only where local conditions are unusual, as in Michigan, with its native-copper ore. Steam stamps are made by the Nordberg Manufacturing Company, and the Allis-Chalmers Manufacturing Company, both in Milwaukee, Wis.

USEFUL OPERATING IDEAS

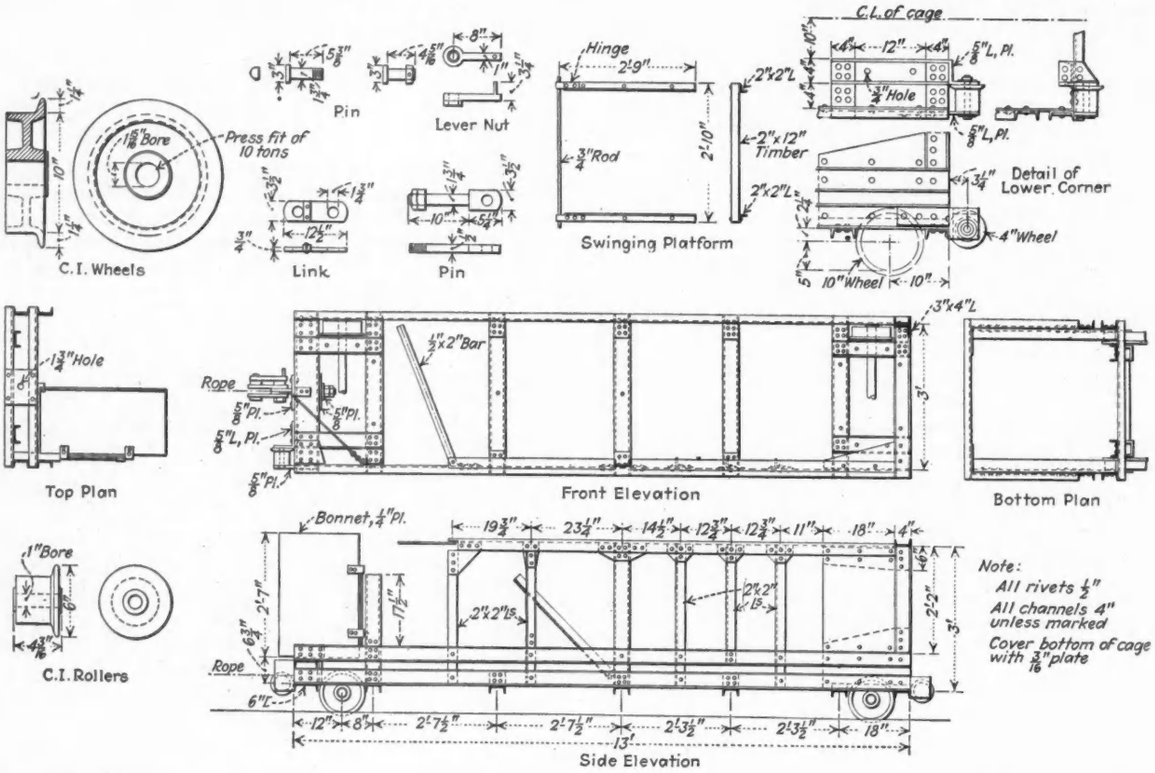
Cages for an Inclined Shaft

By J. C. Pratt
Cerro de Pasco Copper Corporation, Casapalca, Peru

IN EVERY mine a number of special appliances are usually to be found which are made to fit conditions at that particular property. These appliances will differ in some respects from the recognized standards of machinery, equipment and methods. At the same time, inasmuch as similar conditions often exist in widely separated places, these devices may be found useful, perhaps with slight modifications, in mines other than the one for which they were developed. In describing a certain piece of equipment, however, it is necessary to state the conditions under which it is used.

wheels off the track, which was the primary reason for building the cages. In addition, it was impossible to handle both ore and materials with the former equipment; the shaft was always overworked and ore hoisting was delayed. Other disadvantages were also involved, such as the risks to life and limb in skip riding.

Framework—The framework of the cage is of structural steel, which gives sufficient rigidity and strength and is very light; the weight of the completed cage is only 2,100 lb. Two 4-in. channels run the entire length of the cage on each side, forming its backbone. The rear side, against the track, is covered with $\frac{3}{16}$-in. plate, supported by transverse channels at convenient intervals. Although the cages in use have no plates on the two sides, other than small gussets and the two large ones at



Construction details of cage for inclined shaft used by Cerro de Pasco Copper Corporation at Caspalca, Peru

The cages described in the following are used in a shaft inclined 70 deg. from the horizontal. They run on tracks of 3 ft. gage, carried on stringers along the footwall. The inclination is sufficiently steep to permit the general design to follow that used for ordinary mine cages in vertical shafts. Besides raising and lowering the men, the cages handle a large quantity of supplies and timbers 20 ft. or more in length. Before they were installed, timber was lowered in two-ton skips. The long pieces overbalanced the skip and lifted its lower

the bottom of the lower deck, the sides could be covered with plates also, in which case one or two of the small angles could be left out.

The large gussets at the bottom are necessary to give strength to the lower deck, and to keep small articles such as moils from falling out. The lower deck, which is framed with channels, has two inside 3x4-in. angles to support the wooden platform of 3x12-in. timber. This platform may be removed or renewed as required.

The top deck is hinged so that it may be thrown back

against the rear of the cage to load timber or long drill steel. This deck is made of 2x12-in. timber, bolted to the two side-angles of the deck. When the deck is in place, the angles rest upon the side channels of the frame.

Trucks—The bearings of the main wheels are mounted on vertical channels, the flanges of which face the front; these in turn are riveted to the transverse channels of the rear. Wheels and grease cups are completely inclosed by removable plates, which may be fitted in place after assembly. Thus nothing can be caught or jammed against the wheels.

A three-point suspension design might have been used, with the universal joint on the upper trucks. Undoubtedly this device would be preferable in a shaft having bad tracks, because of the length of the cage.

Auxiliary Wheels—As will be seen from the position of the main wheels, a very long curve would be required in running the skip on or off between the shaft and the horizontal storage space for skips and cages to keep the ends from dragging and thus lifting the wheels off the track. Inasmuch as the space for changing skips and cages is small (the original layout did not contemplate the use of cages), it was necessary to put on auxiliary wheels at top and bottom. (I have since seen the same device described in *Engineering and Mining Journal* for another installation). By doing this, we were enabled to use very short lengths of tracks to connect the shaft with the station when changing, which not only allowed operation within the limited space but also facilitated the placing of the connecting tracks. The supports for these wheels should be sturdy, for they may receive rough usage if the cage is lowered or raised too fast.

Bonnet and Crosshead—The bonnet is hinged as on standard cages, so that it can be thrown open for long timber. A lug fastened to the crosshead prevents the leaves from falling beyond center.

The crosshead consists of two transverse 6-in. channels, securely fastened to the vertical channels of the frame. Plates, $\frac{3}{4}$-in. thick, are riveted to the top and bottom flanges, and through these the main pin for the rope passes. The pin is lugged at the top to prevent it from moving when the rope is slack; at the bottom are two nuts, the lower one secured by a cotter pin.

It will be noted that the supports for the main truck at the top aid in reinforcing the crosshead, inasmuch as the channels for the bearings are fastened to the rear 6-in. channel of the crosshead.

Changing Device—The old skips, which are still in use, employ the link-and-pin system for holding the rope. It was preferable, therefore, to retain this design rather than make any changes in the skips. At the same time, we had neither the proper steel nor the skilled workmen to make a system of hooks, such as sister hooks, and the literature on quick-changing devices (other than hooks) is limited. We were forced, therefore, to exercise our ingenuity, sometimes an unpleasant task, in making the device shown.

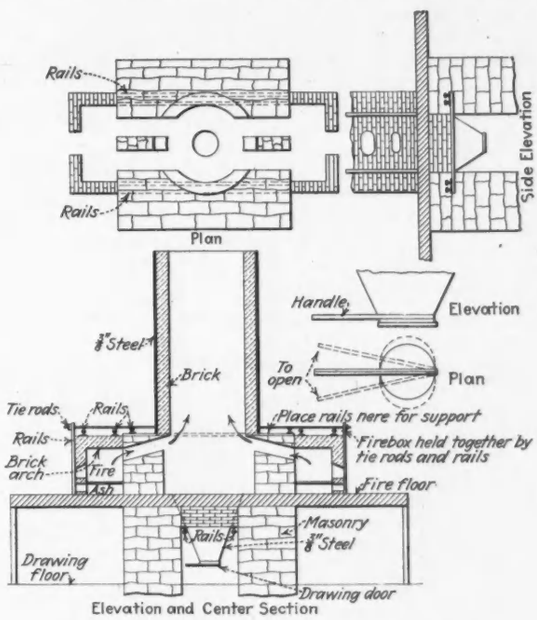
The important feature of the changing device is the lever nut. To replace the rope and thimble, which are held by the upper, horizontal pin, the thimble is slipped between the links and the pin is passed through. The lever nut is then screwed down as far as possible. The weight of its handle or lever is sufficient to prevent the nut from turning, once it is in place. As arranged, the pin itself is held from turning by a lug fastened to one of the links as shown; the head of the pin is flattened to fit against the lug. A good feature is that the device is absolutely safe, since neither pin nor nut can turn if properly made and put together. The lower, horizontal pin is held by a cotter pin passed through the nut; this pin, of course, is never removed.

The cages have now been in operation for six months or more, and not only have they speeded up work in the shaft, but they have proved practical in every detail.

A Convenient Lime Kiln

By Herbert E. Schmidt
Duluth, Minn.

IN RESPONSE to the request of your correspondent in Central America in the issue of Nov. 26, 1927, I submit the following sketch showing a lime kiln used by



Sectional detail of kiln for burning lime

a local company. It is larger than requested, but the idea is there.

Careful attention must be given to the placing of tie rods and rails, as heat is likely to injure the masonry. Sawdust and slack coal are the fuels used. The local plant has a trestle running over the top of a row of these kilns for charging purposes. No fines are used—only lump lime. The fire-box door and the flues leading into the stack are so arranged that the limestone may be poked by the channel when it "hangs up." The rock does not "hang up" anywhere else.

Value of Whitewash Underground

At the Athens mine, Negaunee, Mich., shaft stations, ventilation doors, and roofs and walls of the drifts adjacent to them, also the refuge stations in haulage drifts, have been whitewashed. It is surprising how much better the illumination is since this was done, it is said. As one travels through a haulage drift the safety zones show up clearly. A mixture of a small amount of cement with slaked lime makes it adhere better to damp walls. The National Safety Council recommends this procedure for all mines. The Athens mine is operated by the Cleveland-Cliffs Iron Company.

INDUSTRIAL PROGRESS

Motor Trucks Supplanting Mules in Chilean Nitrate Field

THE use of motor transportation in the nitrate desert of northern Chile has advanced rapidly within the last two years, and this in spite of the serious depression in the nitrate industry and the fact that three-fourths of the 65 plants in this region were closed, according to George D. Hooper, U. S. Consul at Antofagasta, in *Commerce Reports*, issued by the U. S. Department of Commerce. For many years the practical use of motor trucks in handling nitrate ores was discounted, and leading engineers at the plants refused to entertain propositions that machinery could take the place of the high two-wheel mule cart for the transportation of ores from the mines to the plants. The shutdown in 1921 and the more serious depression of 1925 and 1926, which is not over even yet, caused plant managers to realize that the upkeep of a large number of mules and their drivers when plants were closed remained a steady factor, while a motor truck when not in use has little overhead cost. This fact, together with the efforts of American motor-truck and tractor manufacturers, proved so convincing that within one year, and during the crisis in the leading industry, the number of trucks and tractors in use in the nitrate fields has increased by 75 per cent. Up to Dec. 31, 1926, the number in use in this district was 177, and since that time 193 more have been imported. Of this total of 370, about 85 are engaged in passenger business, with 65 of them in Antofagasta. About 40 light trucks are used in transfer and hauling in the city, an increase of about 200 per cent in two years. The remaining 245 trucks of all sizes, of which nearly 40 per cent are of 1½-ton size, are now used in the nitrate fields and copper mines.

The Chilean nitrate desert is a dry, mountainous, and rocky region, absolutely devoid of vegetation or rainfall. Although the average altitude in the nitrate fields is 5,000 ft. above sea level, it is usually very hot, dusty, and windy during the day, and chilly at night. The air is so dry and salt that it is difficult to keep machinery in good condition, even with constant care. Road construction has been slow, owing to lack of government support. With a steady and comparatively small expenditure annually, great improvements might be made in the roads throughout the nitrate desert. As washouts and drainage problems are not factors needing consideration, road building is mainly a matter of leveling, grading, and a little filling in at sharp points. Rock exists in abundance all over the desert and is easily available.

Around the nitrate plants, often within a radius of a half mile, are found the deposits of nitrate ore commonly called "caliche." From its shallow depth of 3 to 12 ft. it is blasted loose, broken up by hand, and prepared for transportation to the mills. For a long time it was thought that the uneven surface of the ground, especially after blasting operations, would make it far too difficult for a motor vehicle to reach the broken ore; but it was shown by engineers that a little change in the old method of piling rocks and ore would allow room for roads at a low cost, so that motor trucks might operate to and from the mills. In the more difficult cuts or ravines it was shown that tractors could be used instead of trucks; although their speed is less, their power and tonnage are greater than mule carts.

Left—American motor truck releasing detachable body, which slides flat to ground where it is filled by workmen, then pulled back on truck by motor and taken to mill. Rear wheels must be braced before body is lifted back. Right—Same truck dumping into railroad cars. Because of ruts in the loose sand and gravel of the average desert road, a truck with high wheel-base and plenty of power is needed

Electric Welding—A Résumé

ARC WELDING in its most familiar form consists in manually maintaining an arc between an electrode wire and the parts to be welded. The heat of the arc fuses the parts to be welded and fuses and consumes the electrode wire. This metal from the electrode passes through the arc and is deposited on and combines with the fused metal of the parts being welded. One pole of the welding generator is connected to the work and the other, through a suitable electrode holder, to the welding wire. The operator advances the wire at the rate it is consumed, so as to maintain a constant arc length and a constant arc voltage.

More recent developments have substituted a wire-feeding device for the manual operation. The speed of this wire feed is controlled by a voltage regulator connected across the arc. This control is operated through a suitable reversing clutch, and the entire operation of striking the arc and maintaining a constant arc voltage thus becomes fully automatic.

Automatic welding substitutes ma-

chine-like precision for the unavoidable variations of manual operation, thus insuring a higher and more uniform quality. It increases welding speeds through a more accurate voltage control and the maintenance of higher current values than is possibly manually. Automatic arc welding is continuous, because continuous lengths of wire are used. Hand welding is intermittent, as only short lengths of wire can be used.

A still more recent form of electric welding is that known as atomic-hydrogen welding. In this process an arc is maintained between two tungsten electrodes. A stream of hydrogen, emerging from the electrode holder, envelops the electrodes and thus prevents their oxidation and at the same time acts as the heat carrier. The hydrogen molecules are dissociated by the intense heat of the arc into the atomic state. Upon striking the relatively cool surfaces being welded, these atoms recombine, with the liberation of intense heat. The intensity of the heat and the complete shielding of the fused metal with hydrogen, preventing contamination by the oxygen and nitrogen, result in the formation of an unusually sound, smooth, and ductile weld. It also makes possible the welding of many alloys that have not readily lent themselves to welding by other processes.

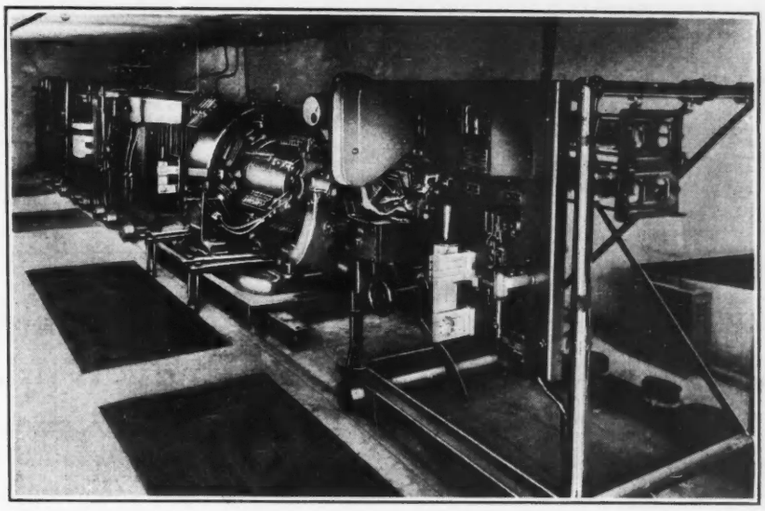
The foregoing is from an address by C. L. Ipsen, delivered at the meeting of the Association of Edison Illuminating Companies, which was held in Colorado Springs Sept. 26 to 30, 1927.

A Novel Power Cable

A new kind of cable for long-distance transmission of electric power has recently been developed by the New York Edison Company and the United Electric Light and Power Company. In the center of the cable is a hollow core, about three-quarters of an inch in diameter, which is filled with insulating oil. This cable is 12 miles long, is operated under a pressure of 132,000 volts, and carries approximately 125,000 hp. This is twice the highest pressure ever attained and three times the greatest amount of energy ever transmitted through an underground cable in the history of electrical engineering. The conductors are thus constantly submerged in a casing of oil, so maintained that nothing outside can come in, and any leakage from within, indicating a fault, may be readily detected and corrected.

Corrosion-Resisting Pipe

Toncan iron, which is not materially affected by rust or by corrosion from acids and alkalis, is now being used by the Naylor Spiral Pipe Company in its spiral "lock-seam" pipe. This pipe is said to be absolutely smooth inside and of true diameter, thus giving a minimum of frictional resistance. Use of a corrosion-resisting metal in its manufacture is expected to give it an even longer life. The spiral seam is welded to the wall of the pipe.



A mine substation which can be moved to a new location in eight hours

Move Substation Quickly

A PORTABLE mine substation which can be moved to a new location in approximately eight hours has been installed at a colliery in Illinois. Operation of the mine necessitates moving the converter substation every three to six months to maintain the desired voltage of the direct-current supply at the face.

The substation is unique. It is equipped with a G-E semi-automatic, 200-kw. synchronous converter, with transformer and control apparatus, all arranged to permit rapid moving. Transformer, switchboard, and control panels are mounted on trucks of the same gage as the mine tracks. After the set has been moved, the unit is bolted and grouted to the floor.

The Modern Blow-Torch

In some industrial heating applications, such as soldering and brazing, a flame temperature less than that obtained with oxy-acetylene can be used to advantage. With burners designed for the admixture of atmospheric air, acetylene alone will give a flame hot enough for many purposes.

The small gas tanks used for truck and motorcycle lighting for years have found applications in the industrial field also. An inexpensive outfit has been developed by the Prest-O-Lite Company, New York, consisting of a light blowpipe handle and a set of special tips giving flames suitable for a wide range of work. It is most conveniently used with a small gas tank and a 6-ft. length of hose.

Gear Makers Merge

Consolidation of the Van Dorn & Dutton Co., of Cleveland, the William Ganschow Co., of Chicago and Peoria, the Fawcus Machine Co., of Pittsburgh and Ford City, and the Ohio Forge Co., of Cleveland, has just been announced. This is viewed as one of the most forward strides taken in the gear industry.

BULLETINS

MOTORS—Two bulletins issued by General Electric on motors are as follows: GEA-529A, low-speed synchronous motors for direct connection to reciprocating compressors and GEA-61A, constant-speed d.c. motors, type CD, 3 to 200 hp. Other G-E bulletins are: GEA-545B, automatic supervisory equipment, selector type, for control and indication of remote power apparatus; GEA-570A, hand-starting compensators for squirrel-cage induction motors; and GEA-858, on low-speed d.c. generators for direct connection to steam or internal combustion engines.

WIRE SCREENS — Sixty-six leading makers of vibrating screens, revolving screens, bolters, filters, pulverizers, and other screen-controlled equipment, have co-operated with the Ludlow-Saylor Wire Company in the production of the latter's new screen book entitled "Getting Results With Ludlow-Saylor Screens." This book is a handsome volume of 190 pages, strongly bound. Topics covered include: Controlling crusher wastes with woven screens; points to consider in choice of sizing screens; reference data on double-crimped wire cloth and woven screens; and special wire cloths for unusual services.

TRANSMISSION—Applications of Hele-Shaw hydraulic pumps and motors to heavy machinery are described in Catalog C of the American Fluid Motors Company, Philadelphia. Application of high-pressure power to a variety of machinery drives is illustrated. The variable and reversible discharge of the Hele-Shaw pump and the simplicity with which it can be controlled make it an extremely sensitive and flexible drive, it is asserted.

WELDING — Torchweld Equipment Company, 224 North Carpenter St., Chicago, has issued a new catalog, No. 28, of 36 pages, and containing much data on gas-welding and cutting equipment.

NEWS OF THE WEEK

Summary

NEW slag-treatment plant of the Anaconda Copper Mining Company, at East Helena, Mont., is placed in operation.

* * *

Wolf expedition which left New York last June is granted two mineral areas in Dutch Guiana, aggregating 100,000 acres, containing a large tonnage of high-grade bauxite.

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Pioneer placer miners declare the day of the individual operator in Alaska is over. Airplane services established at Anchorage and Fairbanks prove of value.

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U. S. Bureau of Mines issues reports on mining operations during 1927 in California, Colorado, New Mexico, South Dakota, Texas, and Wyoming.

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Construction of a 200-ton concentrating plant is to be started at once on the old Tybo property, 60 miles east of Tonopah, by the Treadwell-Yukon Company.

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Several groups conduct active operations in the Dahlonega district of Georgia with the view of developing the deeper gold ores of the region.

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American Institute of Mining and Metallurgical Engineers announces program of annual meeting to be held in New York City, February 20-23.

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New Louvain library will be dedicated on July 4 of this year, according to present plans, says Engineering Foundation.

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Hecla Mining Company at Burke, in the Coeur d'Alene district, Idaho, considers reopening the Tiger-Poorman mine.

Preparations Made To Study World Mineral Situation

Director Scott Turner of the Bureau of Mines Invites C. K. Leith to Make Suggestions Concerning Organization of the Work

By Paul Wooton
Special Washington Correspondent

TO PREPARE for the increased attention the Bureau of Mines will give the world situation in minerals and other economic subjects, Director Turner has invited C. K. Leith to come to Washington to make suggestions as to the organization of the work.

The Army and the Navy are both greatly interested in the world study, particularly as it affects the strategic minerals. As Professor Leith is particularly familiar with that phase of the subject, it is expected that he will be able to make recommendations of particular value in that connection. This work will be complementary to that done recently by J. E. Spurr.

An allocation of mineral mining investigation funds has been made which will permit of the retention of a specialist of the P-5 class to devote his entire time to the work being done by the Bureau on geophysical prospecting.

Personnel Increased in Health and Safety Branch

With funds made available in the new appropriation bill four additional mining engineers are to be added to the Bureau's Health and Safety Branch. A part of their duties will be to conduct advanced courses in mine safety and first-aid work. An indication of the interest in that work is the filing of a formal petition with Director Turner asking that mine rescue and first-aid training be accorded employees of the branches other than that of Health and Safety.

Bills Call for Six More Mine Rescue Stations

Bills have been presented to Congress calling for the establishment of six additional mine rescue stations. It is pointed out at the Bureau that no further stations can be established without additional appropriations and that the passage of the bills without providing the necessary funds would make it necessary to reduce the amount available at the established stations. As this would impair their service greatly it is felt that the fund should be increased and the Bureau allowed to set up the stations that are most needed.

Manganese Producers Profit From Research Work

Representatives of the producers of domestic manganese advise the Bureau of Mines that there is every prospect in 1928 of trebling their output. They state that their industry has profited greatly as a result of the research work done at the Minneapolis station and ask that it be expanded.

To Build Concentrator on Tybo Property

A 200-ton concentrating plant is to be constructed at once on the old Tybo property, 60 miles east of Tonopah, Nev. The property is under option to the Treadwell-Yukon Company, Ltd., and this information was given out in Tonopah by W. H. Blackburn, who is in charge of mining operations for the Treadwell-Yukon Company, in this section of the state.

Development on the 700 level of the property has been so satisfactory that the first payment has already been made to the owners, the Morey Mining Company. Present plans include, besides mill construction, a new three-compartment shaft, and enlargement of all surface buildings and equipment so as to take care of at least 100 men.

Americans Granted Large Areas in Dutch Guiana

The Wolf expedition which left New York for South America in June, 1927, has been granted two mineral areas in Dutch Guiana, aggregating 100,000 acres, containing an immense tonnage of high-grade bauxite. The grant has been made in the name of the Guiana Mining & Development Company, which was organized by ex-Judge Alexander Wolf while in Dutch Guiana.

Alaska Placer Mining Requires Large Investments

Pioneer Miners Say Day of Individual Operator Is Over—Airplane Services Prove of Great Value

PIONEER placer miners declare the day of the individual operator in Alaska is over, and that the future depends on large aggregations of capital competent to install the most modern hydraulic and dredging plants to enable the lower-grade gravels remaining unworked to be handled at a profit. The airplane services established at Anchorage and Fairbanks are proving of great value in enabling prospecting parties and examining engineers to reach hitherto inaccessible localities without loss of time, and to take full advantage of the short seasons.

The Fairbanks Exploration Company has constructed camps at the town of Chatanika, and at Fox on No. 21, Goldstream, for accommodation of the iron workers employed in putting together the two dredging plants now being transported to Fairbanks over the Alaska Railway. Two to three trains a week are employed in moving the plants from Seward to Chatanika, where extra spurs have been laid to handle the material. As the dredges will be electrically operated, the power plant at Garden Island, Fairbanks, is equipped with three steam turbo-generators, two of 3,500 hp. each and one of 500 hp. The boilers will be fired with coal supplied under a 3-year contract from the Healy Creek mine. Huge cranes have been installed for unloading the equipment from the railway cars and moving it as required. Large air-compressors have been put in at each camp to supply the air required in riveting together the sections of the plants. The dredge buckets have a capacity of 10 cu.ft. Each dredge will handle about 7,000 cu.yd. gravel per day, and the cost of each installed will be between $750,000 and $1,000,000. It is expected that the plants will be in full operation by Aug. 1, enough ground having been stripped and thawed to provide for a full season's operation. A smaller dredge with 6 cu.ft. buckets has been ordered for operation at Gilmore, on upper Goldstream. The two dredges now being delivered will operate on Cleary and lower Goldstream respectively, and it is stated four more dredges will be installed on the company's properties, which include 50 square miles of placer ground on Cleary, Goldstream, Gilmore and Ester creeks. The dredging plants will be connected with the central power station at Fairbanks by transmission lines aggregating 100 miles in length. The Davidson ditch, so named after J. M. Davidson, who built it and the Miocene ditch at Nome, extends from Fairbanks to a point half a mile below the forks of McManus and Faith creeks, a distance of 75 miles. The ditch is 7 ft. deep and has an average width of 12 ft. From Fox Creek a branch of the ditch, four miles in length, runs to Gilmore on upper Goldstream, and the other, seven miles in length, provides the water supply for lower Goldstream operations. The company's total investment in the enterprise is estimated at $15,000,000.

Another important dredging undertaking at Fairbanks is that of the Alaska-Whitworth Mines, Ltd., of London, with which are associated the Tanana Valley Gold Dredging Company, the Whitworth Mines Company, and the Engineer Creek Company. The company is now ready to operate the entire season on Fish Creek and has acquired two and half miles of dredging ground on Engineer Creek, which it proposes to drill. If results are satisfactory a dredge will be in operation there by 1929. Two thousand tons of coal is being hauled to Fish Creek from Gilmore by tractors in preparation for the coming season's operations there.

The Pacific Coast Cement Company is installing its dock and shipping plant, and opening quarries, at View Cove, Dall Island, with a view to supplying the limestone required in its cement plants on Puget Sound. The plant includes electric shovels and conveyors, to provide the power for which a start will shortly be made on a hydro-electric installation. It will be the end of the year before the industry is in complete operation. The Williams Mining Company has been incorporated to develop and operate the Charles Williams lode mining group of 94 claims on Hawk Inlet, near Juneau.

A. Hughes and J. W. Sansom have driven over 1,100 ft. of tunnel in the search for a lost gold-quartz mine, believed to have been buried by a landslide on the Yukon River, 30 miles above Circle. Treadwell interests are stated to have taken up an area on Coal Creek, a tributary of the Yukon River west of the international boundary, with a view to testing it out. Representatives of Michigan capital have been investigating the dredging prospects of Birch Creek, a tributary of the Yukon River, below the confluence with Porcupine River.

The old Chichagoff Island gold mine is being reopened by the Chichagoff Development Company, organized by G. T. Jackson. J. L. Freeburn, who successfully operated it in former years, has returned as manager. A new vein carrying high gold values has been developed. The Merrill Mining Company has been obliged to shut down its mine at Port Wells for the winter owing to the unusually cold weather, which froze the water supply.

The Elmes Gold Mining Company intends to increase its mill at Fairbanks to ten stamps. Sufficient ore has been blocked out to supply such a mill for a year. The Marion-Twin Gold Mining Company is adding another ten-stamp mill and two 100-hp. Diesel engines to its plant at the Gold Mint mine on Little Susitna River. The company has also arranged to operate its Craigie Creek properties during the coming summer.

The Kassan Gold Company states that the company's offices are situated at 315 Railway Exchange Building, Seattle, Wash., and that movement of the offices to Spokane is not contemplated. *Engineering and Mining Journal* is glad to have an opportunity to here correct a statement appearing in the December 24 number to the effect that the company's offices had been moved to Spokane.

Anaconda's Electrolytic Zinc Capacity Now 30,000,000 Lb. a Month

OPERATION of the newly completed $2,000,000 electrolytic zinc plant of the Anaconda Copper Mining Company began Jan. 23, and will ultimately employ 300 men. Construction of the plant was started early last summer with a force of 800 workmen. Maximum activities are expected to be under way in about a month's time.

By the opening of this new plant, the output of "Anaconda Electrolytic" zinc in Montana will be increased approximately 50 per cent. The enlarged plant at Great Falls has a capacity of 335 tons of cathode zinc per day, or 240,000,000 pounds per year. The new Anaconda plant has a capacity of 165 tons daily, or 120,000,000 pounds per year, making the company's total capacity 360,000,000 pounds per year.

The plant at Anaconda, like that at Great Falls, will treat ores shipped from the Coeur d'Alenes and Salt Lake districts and will also receive the bulk of zinc ores produced in the Butte area.

The new plant is divided into four main divisions, roasting, leaching, electrolyzing and casting. For the three last-named divisions modern, fireproof buildings of brick and steel have been erected. Similar new structures house the zinc residue dryer and the electrical substation. The roasting division occupies the eastern half of the present No. 2 roaster.

This new electro-chemical industry at Anaconda represents a substantial addition to the commercial load of the Montana Power company, its requirements being in excess of 33,000 horsepower.

Hydraulicking gold gravel on the Chestatee, near Dahlonega

Seek to Revive Old Gold Camp at Dahlonega, Georgia

By Claud Hafer
Mining Engineer, Southern Pines, N. C.

DAHLONEGA, Georgia's most famous gold "camp," boasting a record of production close to $20,000,000, is showing symptoms of revival. The town is situated about 75 miles northwest of Atlanta. Most of the early production was accounted for by a unique treatment combining hydraulicking with giants and light stamp mills. On those veins in which sulphides were disclosed, little underground mining was ever attempted. At the present time several groups are conducting operations looking to the exploitation of the deeper ores.

An interesting development has been under way on Findley Ridge—just south of Dahlonega—by a Canadian syndicate. Here the gold is contained in saprolite and inclosed quartz stringers. The ridge and adjacent territory have been sampled and numerous surface pits and shafts sunk to determine the depth and extent of the soft ore. One shaft was sunk to a depth of 55 ft. before reaching hard ground, and from this exploratory crosscuts and drifts have been extended. Three other shafts were lately under way to continue the work. It is reported that a large body of low-grade ore exists that can be mined by steam shovel to a depth of 75 ft. or more. The erection of a 50-ton pilot mill has been started, and if sufficient ore can be proven, it is possible that a modern gold mill, of cyanide type, capable of treating 500 tons of ore a day, will be erected.

Exploration is under way at the Findley mine, operated by the Dugas Corporation, of Atlanta. The Findley is an old mine with the reputation of considerable production. Old opencuts, tunnels, and mills bear evidence of former activity. Interest seems to have been centered along a zone which is either a vein or a system of veins or lenses named at different points the Dead Horse vein, the Parallel, the Belle shoot, and the Findley shoot. The Dead Horse, now little developed, is reputed to produce $10 ore. The most famous is the Findley shoot, which lies several hundred feet southwest of the Dead Horse. From what is visible now, it appears to be an ordinary vein of white quartz common to the country, but its peculiarity was that it made pockets of coarse gold, wire, and nuggets. These are said to have occurred at intervals of approximately 55 ft. The first one is supposed to have produced $22,000—the last about 30 ft. above the present bottom, $92,000, with a total output of $275,000. It was evidently a pipe or chimney, and the adjacent portions of the vein are apparently of value insufficient to be mined, although 15 to 20 ft. to the northeast another shoot, the Belle, was productive. Pyrite and galena are accessory minerals.

The country rock is a hard, unaltered hornblende schist. The ridge in which this vein occurs towers some 500 ft. above Yahoola Creek. In the course of development the chute was opened on the opposite slope, near the summit of the ridge, but several crosscuts have been driven from the creek slope. Present work is being carried on through one of these 200 ft. above the creek. Near the portal is the temporary power plant, where a Chicago Pneumatic compressor with a capacity of 100 cu.ft. per minute, gasoline driven, is located. Also, a generator, driven by a four-cylinder direct-connected Kohler gasoline motor, gives current for lights and blasting. From a point 167 ft. from the portal and 50 ft. to the left, a raise has been started and now is being put through to connect with the bottom of the irregular opening that marks the course of the Findley shoot. After this is accomplished it is the intention of Colonel G. C. Dugas, who is directing the operation, to explore the Findley shoot, the Belle shoot, and the Dead Horse shoot at lower levels than any work has been done heretofore. A ten-stamp mill (1,200-lb. stamps) is being constructed. Amalgamation will be practiced, followed by concentration or cyanidation or both.

The Saprolite Gold Mining Company is installing a 200-ton washing plant near Auraria, 6 miles southwest of the town of Dahlonega, to treat material similar to that on the properties controlled by the Canadian syndicate, but is approaching the problem from the point of view of the placer miner. The property lies on the east bank of the Etowah River, and is a long ridge, with its maximum height 185 ft. above the river and 65 ft. above the main floor of the working. There are seven shafts on the property and a tunnel 250 ft. in length. John E. Logan, the manager, says that all of these openings have been sampled and indicate a soft saprolite deposit extending below the present floor of the working and of areal extent sufficient for several years' work. A sawmill has been erected and complete wood working plant will be added to furnish lumber for building plant and camp. Dwellings are to be constructed, and bunk and recreation houses for operatives. Grading is under way for a washing plant.

A number of new ideas are involved. Mr. Logan proposes to begin his work by plowing the sloping surface of the ridge with heavy plows drawn by Fordson tractors. The loosened saprolite will be picked up and delivered to the receiving bin of the plant by Miami-Trailer scraper. The maximum distance of delivery for some time to come will be 700 ft., although the pay dirt extends nearly to the plant site. It is estimated that at a distance of 1,000 ft. one man with a Fordson tractor can load a scraper, transport the load 500 ft., and return in 4½ minutes. The capacity is 18 to 20 cu.ft. per load.

On the Turkey Hill property 3 miles south of Dahlonega is an outcrop of pyritic ore containing gold and copper. It extends apparently ¾ mile through the property and measures, where exposed by streams cutting the outcrop, up to 100 ft. in width. The outcrop is siliceous schist impregnated heavily with pyrite, and contains gold. Along the footwall side the schist is soft on the outcrop and contains quartz stringers with accompanying free gold. Assays show value up to $5 per ton. This free gold zone is now being explored by a shallow drift along the strike, with the intention of crosscutting the formation. Near Dawsonville is another sulphide outcrop, a quartz vein some 6 ft. in width, assaying several dollars per ton. These deposits were regarded as "refractory" ores in the days of mining activity, but through the development of flotation they became worthy of exploration. Several other small operations are under way in the district, the Liberty Bell, near Auraria, and on the Etowah River a placer situated a short distance below Auraria.

Metal Mining in New Mexico in 1927

THE output of gold, silver, copper, lead, and zinc from New Mexico ores in 1927 in terms of recovered and estimated recoverable metal was 27,079 fine ounces of gold, 857,547 oz. of silver, 15,500,000 lb. of lead, 77,000,000 lb. of copper, and 53,600,000 lb. of zinc, according to the U. S. Bureau of Mines. These figures are to be compared with 19,631 fine ounces of gold, 450,934 oz. of silver, 6,960,366 lb. of lead, 81,642,379 lb. of copper, and 24,104,800 lb. of zinc in 1926, and show notable increases for each metal except copper, in which there was a decrease of 4,642,000 lb. The gross estimated value of the output of metals in New Mexico in 1927 was: gold, $559,773; silver, $486,229; lead, $1,050,907; copper, $10,026,900; and zinc, $3,367,587, or a total of $15,491,396, compared with $14,481,808 in 1926, an increase of $1,009,588, equivalent to 7 per cent.

The increases shown for gold, silver, lead, and zinc were all attributable to the production from the complex sulphide orebody of the American Metal Company's mine, on Willow Creek, in San Miguel County.

As has been the situation for many years, the metal of chief value produced in New Mexico was copper. The value of the copper production for 1927 was $10,026,900 compared with $11,429,933 in 1926. The most prominent mining operation in New Mexico is that of the Chino Mines, with electric and steam-shovel open pits at Santa Rita and a 12,000-ton flotation mill, in seven units, at Hurley. This mine produced copper concentrates and copper smelting ore containing 65,124,000 lb. of copper in 1927, as compared with copper concentrates and copper smelting ore in 1926, carrying 76,720,000 lb. The Lordsburg district also produced much copper from a highly siliceous copper-gold-silver ore shipped for furnace linings in copper smelting operations at Douglas, Ariz., and at El Paso, Tex. The district in 1926 produced 97,420 tons of ore, yielding in recovered metals $241,954 in gold, 126,909 oz. of silver, 73,400 lb. of lead, and 4,762,750 lb. of copper. In 1927 it produced 97,000 tons of about the same assay content and recoverable content to the ton as in 1926. At the Burro Mountain branch of the Phelps Dodge Corporation at Tyrone, special leaching operations were continued with a slightly smaller output of copper precipitates than in 1926. Several thousand tons of copper ore was shipped to El Paso, Tex., by the Hanover-Bessemer Iron & Copper Company at Fierro, in addition to several hundred thousand tons of iron ore to the steel plant, at Pueblo. Copper carbonate ore continued to be shipped from shallow shafts at Pastura, Guadalupe County. Nearly 100,000 tons of iron-manganese ore was shipped from Silver City to the steel plant at Pueblo, Colo.

A small quantity of gold and silver was recovered in the scrapping of mill machinery at Mogollon, where mining ceased in December, 1925. There was some production of silver ores from Kingston, Fairview, and Chloride. Gold placers on Ute Creek, and the Aztec lode mine, at the base of Mount Baldy, Colfax County, contributed gold bullion. The Gold Hill district, Hidalgo County, also contributed gold bullion.

The large increase in the production of lead in 1927 over 1926 was from lead concentrates from the American Metal Company's mill, San Miguel County. Lead ores were shipped from the Organ Mountain, Cooks Peak, Hachita, Hanover, Florida Mountains, Los Cerrillos, Steins and Kelly-Magdalena districts.

Metallic Zinc Production Totals 65,000,000 Lb.

Zinc ore and concentrates produced in New Mexico in 1927 amounted to 64,000 tons, containing 65,000,000 lb. of zinc. This zinc production was from Glorieta, Hachita, Hanover, Kelly, Los Cerrillos, and Pinos Altos. The Empire Zinc Company's magnetic separation and flotation mill at Hanover made a smaller output in 1927 than in 1926. The Ozark flotation mill at Kelly was idle in 1927 as compared with steady operation from March to December, 1926. Lessees shipped some zinc-lead ore from Kelly to the zinc pigment plant at Coffeyville, Kan., and zinc sulphide ore to Amarillo, Tex. The Carnahan (formerly Collier) Mines Company operated its 50-ton flotation mill, at Los Cerrillos, and the American Flotation mill at Hachita was operated part of the year, as were the Calumet-New Mexico and Jackson mills, at Pinos Altos. The American Metal Company's 600-ton selective flotation mill at Glorieta was operated steadily from the middle of January throughout the year.

Gold Production Increases in South Dakota

In 1927 the Homestake mine, the largest producing gold mine in the United States, produced approximately $6,677,000 in gold and 92,000 oz. of silver, states the U. S. Bureau of Mines. In 1926, the Homestake and several small gold mines in South Dakota produced $5,778,376 in gold and 82,186 oz. of silver. The ore of the Homestake mine averages about $4 in gold and is treated by amalgamation, followed by cyanidation of the sands and slimes.

Texas Metal Production Mainly From One Mine

Metal mines in Texas in 1927 produced 400 oz. of gold, 1,000,000 oz. of silver, and 500,000 lb. of lead, according to the U. S. Bureau of Mines. The greater part of the production came from the Presidio mine at Shafter, Presidio County, operated by the American Metal Company. This mine has been a consistent producer since 1885. The total production of Texas from 1885 to 1927, inclusive, mostly from this mine, is 18,987,000 oz.

Output of Metals From Mines in California in 1927

THE value of gold, silver, copper, lead, and zinc produced at mines in California during 1927, according to the U. S. Bureau of Mines, was $16,768,500, a decrease of $3,282,301, or 16 per cent, compared with the value of metals produced during 1926. There were decreases in value of approximately 2 per cent in gold, 30 per cent in silver, 26 per cent in copper, 73 per cent in lead, and 66 per cent in zinc, compared with the previous year.

Production of gold during 1927 is estimated at 566,600 oz., valued at $11,711,800, compared with 576,798 oz., valued at $11,923,481, produced in 1926. The gold output of lode mines was less than that produced in 1926, but the dredge and other placer output was larger than that of the previous year. The chief gold-producers were the dredges of the Yuba Consolidated Gold Fields and the Natomas Company of California; the Empire, North Star, and Idaho Maryland lode mines, of Grass Valley; the Sixteen to One mine, at Alleghany; and the Central Eureka, Kennedy, and Argonaut mines, on the Mother Lode, in Amador County. Many small lode and placer mines were in operation in 1927.

The silver production in 1927 is estimated at 1,568,300 oz., valued at $889,200, compared with 2,022,460 oz., valued at $1,262,015, in 1926, a decrease of 22 per cent in quantity. The California Rand Silver mine was the largest producer of silver, followed by the Walker and Engels copper mines and the Palisade (Grigsby) silver mine.

Production of copper in 1927 is estimated at 26,749,900 lb., valued at $3,477,500, a decrease of 20 per cent in quantity, compared with 33,466,299 lb., valued at $4,685,282, produced in 1926. There was a smaller yield of copper from Shasta County mines than in 1926, as the Mountain Copper Company shipped no copper ore and the California Zinc Company was active only part of the year. Balaklala shipped regularly. The Engels and Walker mines, in Plumas County, maintained production. The Island Copper Company increased output, but the Calaveras Copper Company did not conduct operations after January.

Because the price of lead was lower in 1927 than in 1926, most of the lead mines in Inyo County did not ship during the latter half of the year, and as a consequence the output of lead in California in 1927 was 69 per cent less in quantity, and its value was 73 per cent less, than in 1926. The total output of lead in California in 1927 is estimated at 2,541,000 lb., valued at $172,000, compared with 8,093,513 lb. valued at $647,481, produced in 1926. The Darwin mines were the largest producers, followed by the Catalina Island, Tecopa, and Mecca mines.

Zinc produced in California in 1927 is estimated at 8,247,800 lb., valued at $518,000, a decrease of 60 per cent in quantity compared with 20,433,887 lb.,

valued at $1,532,542, produced in 1926. Because the price of zinc was lower in 1927 than in 1926, with a lack of foreign market, neither of the large producers of zinc sulphide concentrates, the California Zinc Company and the Santa Catalina Island Company, made shipments after August.

The largest producer in Siskiyou County was the Buzzard Hill lode mine, near Happy Camp. The Schroeder lode, near Yreka, and Mason and Garlock lode, near Fort Jones, were also productive. Hydraulic mines near Forks of Salmon, Happy Camp, Sawyers Bar, and in Scott Valley had good water. The Bonanza King, near Carrville, and the Hazel D, near Denny, were the most important gold lode mining operations in Trinity County, though the Island Copper Company produced the largest tonnage of ore. Hydraulic mines in Trinity County had a successful year. The Trinity and Lewiston dredges worked throughout the year, but the Estabrook dredge was not operated after September. A new dredge is planned for some ground near Trinity Center. There was considerable activity in the gold lode mines in the French Gulch district, Shasta County. Two dredges were in operation and a third was building on Cottonwood Creek. The California Zinc Company produced zinc concentrates from Bully Hill and Ingot ores until September. Mountain Copper Company expanded its pyrite operations, but shipped no copper ore. Balaklala copper mine shipped regularly to the Mason Valley smelter.

Feather River Dredge Dismantled

In Butte County there was little lode mine activity, but development was under way at several drift mines, in the course of which gold was recovered. The last dredge on Feather River, near Oroville, was dismantled during the year. The Yuba Consolidated dredges near Hammonton, Yuba County, produced more gold than any other operation in the state. In Plumas County lode mines near Greenville, Johnsville, Seneca, and Spring Garden were in operation. The Engels and Walker copper mines were productive throughout the year, and placer mining was carried on at about the same scale as in 1926. Lode mines in Sierra County, near Alleghany, Downieville, and Sierra City, were more active, and much work was done at drift mines in the vicinity of Gibsonville and La Porte. At Grass Valley, Nevada County, the North Star lode mine made a good production and completed its development campaign. Some good ore is reported to have been opened in the new deep levels. The Empire mines were active as usual, but laid off over 100 men in the fall. Operations were continued at the Idaho Maryland throughout the year. The company was refinancing for work on a larger scale. Development was under way at the Allison, Boundary, and Randolph mines. The Champion, Le Compton, and Murchie lode mines, near Nevada City, and the Twin Sisters, near North Bloomfield, were developed. Activity at the placer mines in the county was about the same as in 1926.

A new dredge company entered the Natoma field, Sacramento County, putting one dredge in operation and building a second. At the north end of the Mother Lode the Three Queens lode, near Foresthill, Placer County, and the Sigler lode, near Greenwood, Eldorado County, were the largest producers, and development with some production was made at various lode properties near El Dorado, and at several others near Georgetown, and Placerville.

Amador County Mines Most Productive on Mother Lode

Amador County mines, including the Argonaut, Central Eureka, Kennedy, and Moore, were the most productive on the Mother Lode, and the Pioneer at Pine Grove was a producer. Mining was rather dull in Calaveras County, but lode mines near Fourth Crossing, Glencoe, and Westpoint and drift mines near Altaville, Mokelumne Hill, and Vallicita were productive. The Carson Hill mines remained closed, pending refinancing, and the Calaveras Copper Company shut down late in January. In Tuolumne County gold lodes near Columbia, Jamestown, Sonora, and Tuttletown were worked to some extent and development was under way at both lode and drift mines at several localities. The Original mine at Clearinghouse was the largest producer in Mariposa County. The Feliciana mine was further developed and several smaller mines in the Hornitos, Mariposa Grant, and Whitlock areas made a saving of gold. The Virginia mine, near Coulterville, was reopened late in the year, and several mines near Kinsley were brought under one control, looking to development in the future.

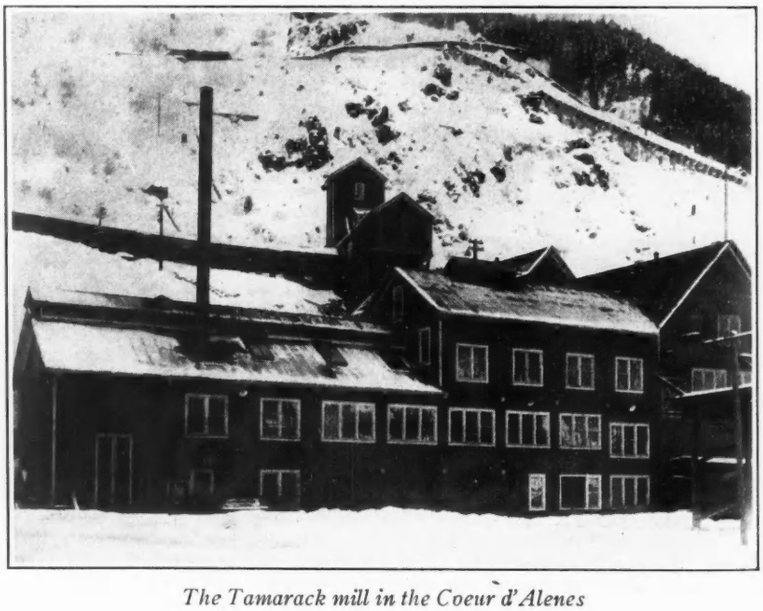
In Kern County the principal gold production was made by the Yellow Dog and Nancy Dare mines, near Mojave; the Tropico, near Rosamond; and the Yellow Aster at Randsburg. The Zenda mine, near Caliente, was productive part of the year. Most of the lead mines at Darwin, Keeler, Tecopa, and Trona, Inyo County, did not ship after midsummer, which accounts for the great reduction in quantity of lead produced in 1927. In San Bernardino County the California Rand Silver was the largest individual producer.

Prospecting in the Calico district was under way to determine the possibilities of reviving this famous silver camp. The Ord copper-gold mines, south of Daggett, were reopened by the Consolidated Virginia Mines Company of Nevada. Siliceous copper-gold ore was shipped from the Vontrigger mines, north of Goffs, and mines near Victorville continued production. There was some production from the Mecca mines, in Riverside County, and from the Julian district, San Diego County. The lead-zinc mines on Catalina Island produced until July.

T. & C. Mines Among First in Coeur d'Alenes

Properties of the Tamarack & Custer Consolidated Mining Company constitute some of the oldest locations in the Coeur d'Alene district. The mine is located high up on the Nine Mile side of the mountains that divide Nine Mile and Canyon creeks. The mill, which is shown in the accompanying illustration, is situated on Canyon Creek at Frisco.

The ore mined at the properties is a coarse mixture of galena and sphalerite, which occur as separate segregations, with galena predominating. Delivery of the ore from No. 5 tunnel is made by an aerial tramway two miles in length. The ore from No. 7 tunnel is moved in open railroad cars. Concentration at the mill involves jigging, tabling, and flotation.



The Tamarack mill in the Coeur d'Alenes

London Letter

By W. A. Doman
Special Correspondent

Ashanti Goldfields Strikes Rich Ore Below Obuasi Shoot

London, Jan. 17, 1928. — Greater interest is now being taken in the position at the Ashanti Goldfields property (West Africa) than has been evinced in many months. For a long time profits have been earned from the orebody known as the Obuasi, although it is by no means rich in the upper levels. In the early days the rich Côte d' Or reef was worked, but this seems to have been lost at about the 7th level. In sinking the shaft below the Obuasi shoot, a very wide and rich lode has been encountered at the 21st level. Prospecting has proved this to extend upward in such a direction as to suggest that it may prove to be the continuation of the Côte d' Or. It runs to 40 or even 50 ft. in width and assays as high at 46 dwt. It is regarded as a really sensational development. The market is now anxiously awaiting further news as the management announces little or nothing until actual proof is available. The directors certainly do not work the market, and shares are very tightly held. This explains why the stock, which has a nominal value of 4s., is now quoted at 36s.

A short time ago I mentioned that the flotation of a nickel mine in Greece was imminent, and that the Greek government had granted a concession. Much had been expected of this property, with which Lord Inverforth and Sir Thomas Royden are, or were, connected. It was thought that with the substantial advance in the price of the shares of the Mond Nickel Company the opportunity for flotation was favorable. Now I understand the company will not be brought out, though no reason for the decision has been given.

A VERY interesting situation has arisen in connection with the Globe & Phoenix (Rhodesia) and the Rhodesia Exploration Company. Years ago there was a big lawsuit between these two companies in regard to the John Bull claims, in which the Rhodesia Exploration had a 50 per cent interest, on account of extra-lateral rights. There is a similar dispute over some other adjoining claims into which the Phoenix Parallel Reef is supposed to extend. H. G. Latilla, representing the Exploration company, has applied for an examination, which I understand has been refused, and the matter is being taken to the courts. The Globe & Phoenix is really a remarkable mine. According to some experts it should have died a natural death about two years ago, but high-grade ore is continually being found in parts.

Metal-manufacturing industries are also acquiring the "combine" habit. Imperial Chemical Industries, Ltd., has acquired the assets of British Copper Manufacturers, Ltd., on the basis of 1 share of the Chemical company stock for every 2 shares held of the British Copper stock, acquisition dating back to Aug. 1 last. Kynoch, Ltd., and Elliotts Metal Company, Ltd., have also entered into this combination. It is believed that this merger of nonferrous metal manufacturers will place the industry on a firmer and broader basis and safeguard the future in the face of steadily growing competition both at home and abroad. British Copper Manufacturers, Ltd., was formed in 1924, and took over the businesses of Vivian & Sons, Ltd., Williams, Foster & Company, and Pascall, Grenfell & Sons, Ltd., and owns the entire share capital of Grice, Grice & Sons, Ltd.

Hecla Company to Reopen Tiger-Poorman Mine

REOPENING old mines which were abandoned years ago has come to be a not uncommon occurrence in western mining districts. An enterprise of this kind has recently been undertaken by the Hecla Mining Company at Burke, in the Coeur d'Alene district, Idaho, where the old Tiger-Poorman mine is being subjected to the rejuvenation process. The first lead-silver ore shipped from the Coeur d'Alene district was from the Tiger mine, being packed to the railroad at Thompson Falls, Mont., in 1884. The discovery and location of the Tiger was quickly followed by the location of the Poorman property, adjoining it and on the same ore shoot. The two mines were developed by shafts within a few hundred feet of each other. Their workings were soon connected, and eventually they were consolidated as the Tiger-Poorman mine and operated through the Tiger shaft. About twenty-five years ago, the Federal Mining & Smelting Company purchased the Tiger-Poorman, and operated it successfully until about 1912. The low metal prices of that year, and an increase in the zinc associated with the lead, made profitable operations impossible and the mine was abandoned. The Tiger-Poorman joins the Hecla, covering a parallel vein. About ten years ago, in order to avoid possible litigation, the property was purchased by the Hecla company.

The Tiger shaft is sunk from the surface and is 2,200 ft. deep. As is usual with old mines, reports have long persisted that much zinc ore, formerly unprofitable to mine, remained in the old Tiger-Poorman workings, and also that much virgin ground known to contain zinc was left to the west of the shaft. The Hecla company is now engaged in dewatering the Tiger-Poorman, and it is regarded altogether possible that this old mine may again produce. For the present, the plans of the Hecla provide for dewatering down to the 600 level, where an examination of the workings will determine further plans.

Mexico City Letter

By W. L. Vail
Special Correspondent

New Quicksilver Camp Opened Up Near Big Bend

Mexico City, Jan. 19, 1928. — A quicksilver camp has been opened near Big Bend, Texas, across the Rio Grande River from Coahuila. The Chisos Mining Company, in this district, is shipping 600 75-lb. flasks of quicksilver monthly. It is hauled 90 miles by wagon to Marathon, on the Southern Pacific Railway.

The Mexican Congress has adjourned until Sept. 1, 1928. The so-called Labor law, which worried operators considerably in its proposed form, did not get out of the Senate.

The closing down of the Erupcion Mining Company, at its properties in Los Lamentos mountains, Chihuahua, was entirely attributable to the impossibility of continuing operations without a loss at the present low price of metals. The company plans to resume work as soon as price conditions justify. It is paying the transportation of workmen to Juarez or Chihuahua, as they choose.

It is stated in north Mexican papers that a proposition is under consideration by Sonora and Sinaloa mine operators to combine their outputs for the purpose of securing a 12,000-ton monthly shipment to Belgian smelters. Contracts are being prepared calling for cash settlement to be made on the basis of control assays of the ores at Guaymas, Sonora, which will be the point of shipment.

The Borda Antigua, one of the old and profitable properties of the Dos Estrellas company, Michoacan, will be definitely closed, as the ores have been exhausted. The Dos Estrellas, however, continues to take over the output of several small adjacent properties, which keeps the mill in operation.

THE Boleo Copper Company, in Lower California, is reported preparing to develop a considerable area of mineral lands back from the coast and removed from the present field of operations. Practically the entire output from Boleo is sent to Europe. Production of the company or the first eleven months of 1927 is given as 9,565 tons, against 9,253 tons for the corresponding period in 1926. The company expects to increase production considerably during 1928.

The Naica interests in Chihuahua are having considerable trouble with water, and are now experimenting with ores below the water level to ascertain if the values are maintained. Small lots of ores are being shipped.

Construction of a large plant in Mexico City for manufacturing mineral colors is under consideration. Mexico imports over 4,000,000 pesos in mineral paints annually.

Societies, Addresses, Reports

A.I.M.E. to Meet in New York Feb. 20-23

Program Embraces Sessions in Mining Geology, Mining Methods, Non-Metallics, Geophysical Prospecting, Education, and Research

WESTERN men interested in producing the gold, silver, copper, lead, zinc and other metals that come largely from beyond the Allegheny Mountains will find much of interest in the program of the American Institute of Mining Engineers for its Feb. 20-23 meeting in New York. Two of the gold medals of the society go to men associated with mining in the West, Herbert Hoover and S. G. Blaylock, the third going to Dr. John A. Mathews, of the Crucible Steel Company. The medals will be presented at the annual dinner at the Waldorf on Feb. 21, and a large attendance is assured. Other social features of the meeting include a smoker on Monday evening, daily luncheons and group excursions, the one on Thursday, Feb. 23, being to the Perth Amboy plant of the American Smelting & Refining Company, which has for this occasion been thrown open to visitors. There will be numerous technical sessions devoted to geophysical prospecting, mining geology, nonmetallic minerals, metal working, engineering education, mine ventilation and related subjects. Mining methods will be covered in two sessions, milling methods in one, non-ferrous metallurgy in another, and the Institute of Metals will present, in addition to sessions on lead, copper, and light alloys, symposiums on the precious metals and on secondary metals. The program for the sessions in this group follows:

Mining Methods

Wednesday, Feb. 22

9.30 a.m.—"Explosives"—R. M. Raymond, chairman.
"Liquid-Oxygen Blasting at Chuquicamata, Chile"—H. C. Schultz and F. K. Middleton Hunter.

Mining Geology

Wednesday, Feb. 22

9.30 a.m.—R. J. Colony, chairman.
"Ore at Deep Levels in the Cripple Creek District, Colorado"—G. F. Loughlin. Presented by title for discussion.
"Geology of the British Guiana Bauxite Deposits"—L. T. Emory.
"Geology of the Red Lake and Woman Lake Gold Areas, Northwestern Ontario"—E. L. Bruce.
"Research in Processes of Ore Deposition"—Waldemar Lindgren.
"The State and Density of Solutions Depositing Metalliferous Veins"—W. H. Emmons.
"Sedimentary Metalliferous Deposits of the Red Beds"—John W. Finch.
"Ore Deposits Support Hypothesis of a Central Arizona Batholith"—I. A. Ettlinger. (By abstract.)
"Deposition of Ore in Pre-existing Limestone Caves, as Illustrated by the Ore Channels of the Tintic District, Utah"—R. T. Walker. (By abstract.)

Non-Metallic Minerals

Monday, Feb. 20

10 a.m.—Oliver Bowles, chairman.
"Mining and Preparation of St. Peter Sandstone in Arkansas"—D. D. Dunkin.
"Geology and Mining of Diaspore and Flint Fire Clays of Missouri"—H. S. McQueen and C. R. Forbes.
"Geologic Factors in the Development of the Eastern Pennsylvania Slate Belt"—C. H. Behre, Jr.
2 p.m.—H. Ries, chairman.
"The Value of Petrology in the Quarrying and Use of Stone"—G. H. Loughlin.
"Notes on the Genesis of Grecian Magnesite—J. R. Thoenen.
"The Idaho Phosphate Field—New Maps and Data"—G. R. Mansfield.

Geophysical Methods of Prospecting

Monday, Feb. 20

10 a.m.—"Gravity Methods"—E. DeGolyer, chairman.
"The Eötvös Torsion Balance Method of Mapping Geologic Structures"—Donald Barton.
"Gravity Surveying in Great Britain"—H. Shaw.
"The Computation of Eötvös Gravity Effects"—E. Lancaster-Jones.
"Cartographic Correction for the Eötvös-Torsion Balance"—C. A. Heiland.
"Experiments With Eötvös Torsion Balance in the Tri-State Zinc and Lead District"—P. W. George.
2 p.m.—Electrical and Magnetic Methods—Max Mason, chairman.
"Geophysical Exploration for Ores"—Max Mason.
Remarks on "Magnetic Method of Surveying"—L. B. Slichter.
"Certain Applications of the Surface Potential Method"—Warren Weaver.
"Recent Results in Electrical Prospecting for Ore"—Hans Lundberg.
"Earth Resistivity Measurements in the Lake Superior Copper Country"—W. J. Rooney, W. O. Hotchkiss, and James Fisher.
"A New Micro-magnetometer"—Frank Rieber.
"Working Method of Practical Geophysics"—Hans Haalck.

Engineering Education

Monday, Feb. 20

2 p.m.—E. A. Holbrook, chairman.
"Analysis of the Report of the Society for the Promotion of Engineering Education on Mining Engineering"—W. E. Wickenden.
"What the Industry Wants the Graduate to Know"—C. R. Mann.
"Student Training Courses"
Discussion led by Cadwallader Evans for coal mining.
Discussion led by H. T. Morris for a metallurgical plant.

Research Committee

Monday, Feb. 20

A subscription luncheon has been arranged for the members of this committee, Van H. Manning presiding, at the Engineers' Club at noon.

Institute of Metals Division

Paul D. Merica, chairman
W. M. Corse, secretary

This division will offer four regular sessions, two symposiums, and its annual lecture and will also hold a dinner, the latter on Wednesday, Feb. 22, at which W. H. Bassett will give an intimate talk on "Copper and Copper Alloys." The two symposiums on "Precious Metals and Secondary Metals" have been arranged with a view to being of general as well as of special interest to members of the metal division.

Tuesday, Feb. 21

2 p.m.—Lead—R. S. Dean, chairman; George O. Hires, vice-chairman.
"A Study of Certain Alloys of the Lead-Tin-Cadmium System With Reference to Their Use as Solders"—C. E. Swartz.
"Ternary System of Lead-Antimony and a Third Constituent"—R. A. Morgen, L. G. Swenson, F. C. Nix, and E. H. Roberts.
"Some Peculiar Results in Hardness Tests of Lead-Antimony Alloys"—L. O. Howard.
"Behavior of Molybdenum as Resistor in the Electric Furnace"—Henry J. Miller and Marcella Lindeman.

Wednesday, Feb. 22

9.30 a.m.—"Metallography"—Zay Jeffries, chairman; S. L. Hoyt, vice-chairman.
"The Cause of Translation Striae and Translation Strainhardening in Crystals"—M. J. Buerger.
"Grain Growth in Metals Caused by Diffusion"—Floyd C. Kelley.
"Interatomic Forces in Metals and Alloys"—R. F. Behl.
"Twinning in Copper and Brass"—A. J. Phillips.
"Twinning in Beryllium, Magnesium, Zinc, and Cadmium"—C. H. Mathewson and A. J. Phillips.
9.30 a.m.—Symposium on Secondary Metals—E. R. Darby, chairman; G. H. Clamer, vice-chairman.
"Non-Ferrous Secondary Metals Recovered in the United States"—J. P. Dunlop.
"Sampling and Evaluating Secondary Non-Ferrous Metals"—T. A. Wright.
"Classification and Preparation of Non-Ferrous Scrap Alloys and Castings"—H. F. Seifert.
"Contamination of Metal Scrap, Its Effect on the Value, and Suggested Means of Control"—Carl O. Thieme.
"The Modern Non-Ferrous Secondary Metal Producer"—Don C. Blackmar.
2 p.m.—Light Alloys—H. W. Gillett, chairman; E. H. Dix, Jr., vice-chairman.
"Magnesium—Its Etching and Structure"—H. B. Pulsifer.
"Aluminum-Beryllium Alloys"—R. S. Archer and W. L. Fink.

4 p.m. — Annual lecture by Dr. C. H. Mathewson on "Significance of the Twinned Structure in Wrought Iron." President E. DeGoyler, presiding.

6 p.m.—Reception by the chairman to members of the division, followed by dinner.

Thursday, Feb. 23

9.30 a.m. — "Copper" — W. H. Bassett, chairman; Arthur L. Walker, vice-chairman.

"Manganese in Non-ferrous Alloys"—M. G. Corson.

"Alpha Phase Boundary of the Copper-Nickel-Tin System" — W. B. Price, C. G. Grant, and A. J. Phillips.

"Distribution of Tensile Strength in Hard-Drawn Copper Wire"—Frank W. Harris.

"Corrosion of Metals as Affected by Time and by Cyclic Stress"—D. J. MacAdam, Jr.

"Application of High-Vacuum Induction Furnace to the Study of Gases in Metals"—P. H. Brace and N. K. Ziegler.

2 p.m.—Symposium on precious metals—G. F. Kunz, chairman; Thomas A. Wright, vice-chairman.

"Notes on the Refining and Melting of Some Platinum Metals" — J. O. Whiteley and C. Dietz.

"Purification of the Six Platinum Metals"—Edward Wichers, Raleigh Gilchrist, and W. H. Swanger.

"The Platinum Metals and Their Alloys"—F. E. Carter.

"Manufacture of Sterling Silver and Some of Its Physical Properties"—R. H. Leach and C. H. Chatfield.

"The Metallurgical Properties of Precious Metals and Their Alloys Which Affect Their Use in Dentistry"—Reginald V. Williams.

"Gold, Silver, Copper Alloys"—F. E. Carter.

"Use of the Noble Metals for Electrical Contacts"—E. F. Kingsbury.

Non-Ferrous Metallurgy

Wednesday, Feb. 22

2 p.m.—R. M. Roosevelt, chairman.

The Committees on Reduction and Refining of Copper, Lead and Zinc are cooperating in a single program at which the following papers will be presented:

"Suggested Improvements for Smelting Copper in the Reverberatory Furnace"—G. L. Oldright and F. W. Schroeder.

"Metallurgical Treatment of Flotation Concentrates"—Arthur S. Dwight.

"The Waelz Process"—R. Hoffmann.

"Reduction of Roasted Cassiterite Concentrates"—W. W. Loo and E. F. Kern.

"Formation and Decomposition of Zinc Ferrite" — Carl E. Swartz and Francis Krauskopf.

Milling Methods Committee

Monday, Feb. 20

10 a.m.—G. H. Clevenger, chairman.

"Notes on Theories on the Cyanidation of Gold Ores"—J. W. Tudor.

"Soluble Salts in Mill Waters of the Nacozari Concentrator and Their Effect on Flotation"—C. G. McLachlan.

"Crushing and Grinding, I—Surface Measurement of Quartz Particles"—John Gross and S. R. Zimmerley.

"Gas Sorption in Flotation"—A. S. Adams.

Metal Mining in Colorado During 1927

THE conclusion of a report by the U. S. Bureau of Mines on the 1927 mining operations in Colorado follows; the first part of the report appeared on page 184 of the Jan. 28 issue of *Engineering and Mining Journal:*

At Leadville, the Colorado Zinc-Lead Company's flotation mill was operated steadily with a product of lead and zinc concentrate. Some of the zinc concentrate was exported. The feed for this mill came chiefly from the mines of the Leadville Deep Mines Company, in the Carbonate Hill-Graham Park area. The Leadville Deep Mines Company controls the Greenback, Pyrenees, Mikado, Marion, R.A.M., Wolftone, Robert Emmett, and other claims. Lessees on the Ibex and Golden Eagle mines continued to ship siliceous gold ores to the A. V. smelter, at Leadville, to the Golden Cycle mill, at Colorado Springs, and occasionally specimen gold to the Denver mint. The Arkansas Valley lead-bullion and leady copper matte smelter was operated continuously, with only two furnaces in blast. The Western Zinc Oxide Company's oxide furnaces were idle all year. Raising and driving were continued at the Canterbury drainage adit, the last face being in the White (Yule) limestone. Some iron-manganese ore was shipped to the steel mill at Pueblo. In all, about 40 mines were operated at Leadville.

At Climax, or Fremont Pass, the Climax Molybdenum Company's flotation mill was operated continuously at a rate of 20,000 to 25,000 tons a month. This very large blocked-out molybdenum deposit is being worked by the shrinkage stope method. The ore is disseminated through what was a thoroughly shattered Pre-Cambrian granite, now so highly silicified that no timbering is necessary. At Kokomo, Summit County, no work was done. At Montezuma, several lots of ore were shipped.

At Breckenridge, some hydraulicking and sluicing of placer gold deposits were done and the Blue River dredge was operated nearly the entire year. The Wellington mills, one a jig and table-concentration mill, and the other a magnetic-separation mill, were operated through April, when they were closed. These were supplanted by a selective flotation mill, which was placed in successful operation in September, but which was closed on Dec. 1, because of the decline in lead and zinc prices. Lead carbonate ore was shipped from the Detroit mine. At Alma, some lead-silver ore was shipped from the Russia mine and gold ore from the London mine.

In Boulder County, the Fairview Mining Company operated its flotation mill at Cardinal on ores from the Boulder County mine, and lessees shipped silver ore from the Caribou mine, at Caribou. Gold ore was shipped from the Wano mine, at Jamestown, to the Golden Cycle mill, and an attempt was made to mill the fluorspar-silica ores of Jamestown. Bullion was shipped from the Wood Mountain mine, at Sugar Loaf. The Wolf Tongue tungsten mill was destroyed by fire in August, but was rebuilt. From Lake City, Hinsdale County, little ore was shipped, but much building and construction work was done in the county. Silver ore shipped from Creede, Mineral County, carried 207,821 oz., compared with 537,000 oz. in 1926 and 738,000 oz. in 1925.

At Summitville, Rio Grande County, several cars of selected and sacked specimen gold ore from the Little Annie mine contained approximately $120,000 in gold. In 1926 several lots of specimen gold and one car of smelting ore from this mine carried $120,000 in gold content. The Sunnyside selective flotation mill was operated throughout the year at about the same capacity as in 1926—namely, 750 to 800 tons a day. The ore of this mine averages about 0.07 oz. gold, 3.7 oz. silver, 4 per cent lead, 0.4 per cent copper, 4.5 to 7.2 per cent zinc, and 10 per cent iron. To keep as much gold as possible out of the zinc concentrate, a zinc-lead middling is made, which is sent to the Reed-Coolbaugh sulphating plant, at Durango, where the zinc is removed as a zinc sulphate and the residue is sent to the lead furnace of the Durango smelter. Despite the heavy floods which closed the Silverton branch for three months during the summer and again in the fall for several weeks, the Sunnyside company continued to operate and stored its concentrate until able to ship. Development work was done at the Shenandoah-Dives-Mayflower-North Star group and at the Iowa Tiger group.

In the Red Mountain district, on the county line between San Juan County and Ouray County, copper ore and zinc-lead ore were shipped from the San Antonio. Lessees on the upper levels of the Camp Bird mine completed a small amalgamation-concentration mill at the mine, and shipped gold bullion and gold concentrates. The Sutton group, in the andesite breccia, on Hayden Mountain, was operated in 1927, the ore going by tram to a new mill at the mouth of Bear Creek, where it joins Uncompahgre Creek. Development work was done at the American Nettie and a tram built to the new mill in the old Wanakah mill building; some ore was treated, but a fire destroyed the upper terminal of the tram. This terminal has been rebuilt. The Tomboy mine, in the upper San Miguel district, was closed early in 1927, and arangements were made for cleaning up the plant and machinery, because of the falling off in the grade of ore and the consequent prospect of encountering heavy financial losses in continuing mining operations. In the fiscal year ended June 30, 1926, this mill treated 205,435 tons of $3.50 ore at a cost of $3.15 a ton.

The Smuggler Union mine, at Telluride, was operated continuously throughout the year, much of the time through

the Pennsylvania adit, 600 ft. below the Bullion adit. A fire at the mouth of the Pennsylvania adit, late in 1927, hampered mining operations. Zinc-lead ore continued to be shipped from the Black Bear mine, at Telluride.

Producing mines at Ophir were the Carbonero and San Bernardo. At Rico, Dolores County, the International Smelting Company's 250-ton selective flotation mill was closed in May, but was reopened in August and operated the rest of the year. Lead-silver ore was shipped from the Union Carbonate mine, at Rico. Other active properties at Rico were those of the Rico Mining & Reduction Company, the Falcon Lead Company, and the Rico Argentine. Some very rich lots of gold-silver ore were shipped from the Gold King mine, at La Plata, and from the May Day mine, at Hesperus, La Plata County.

Wyoming Metal Production First in Several Years

Metal mines in Wyoming in 1927 produced 58 oz. of gold and 5 oz. of silver, states the U. S. Bureau of Mines. This was the first metal production for several years. The production in 1927 was bullion from the Hidden Hand mine, Atlantic City, Fremont County.

Mining Congress Sponsors Development Conference

The third annual Industrial Development Conference under the auspices of the Southern Division of the American Mining Congress will be held at Gulfport, Miss., March 15-17. The American Railway Development Association of the Southeast will probably hold a joint session. "Economics of Industry" will be the theme of the conference, whose sessions will be held at the New Markham Hotel. The banquet will be held the evening of March 16 at the Southern Hotel. J. G. Bradley, of Dundon, W. Va., president of the American Mining Congress; Dr. Frank L. Hess, of the U. S. Bureau of Mines; and other speakers of national prominence will be on the program. Winter tourist rates will be in effect from practically all parts of the country.

U. S. Civil Service Announces Examinations

The Civil Service Commission announces open competitive examinations for the positions of associate metallurgist, assistant metallurgist, and junior mining engineer.

Applications for associate and assistant metallurgists must be on file with the Commission at Washington, D. C., not later than Feb. 21, and for junior mining engineer not later than Feb. 25. Full information concerning the examinations may be obtained from the U. S. Civil Service Commission at Washington, D. C.

Will Dedicate Louvain Library on July 4

THE Louvain library, destroyed by the Germans during the world war, and restored by American benefactions, will be dedicated on July 4 of this year, according to present plans, says a statement by the Engineering Foundation. The Belgian Ambassador and Whitney Warren of New York, the architect, have both assented to this date, the Foundation announced, and the sanction of the Louvain authorities is expected.

The Foundation is arranging for the presence of a delegation of American engineers at the dedicatory ceremonies. Under the auspices of the Foundation, a clock and carillon will be placed in the tower of the new Library building at a cost of $80,000, to be subscribed by members of the engineering profession in this country. Up to Jan. 25, $32,300 had been contributed by 1,880 engineers in amounts of 25c. to $5,000, Dr. Edward Dean Adams, chairman of the Foundation's committee in charge of the movement, reports. The mechanical engineers lead in the amount of subscriptions, with the civil engineers second, the mining engineers third, and the electrical engineers fourth. Associated societies have given $927, and $5,250 has been received from friends.

The clock and carillon, the gift of 56,000 American engineers, will be installed "in memory of the engineers of the United States of America who gave their lives in the service of their country and its allies in the Great War 1914-1918." Dr. Adams will head the U. S. engineering contingent at Louvain. Other members of the American delegation will be members of the Foundation's committee, including: George W. Fuller, American Society of Civil Engineers; Colonel Arthur S. Dwight, American Institute of Mining and Metallurgical Engineers; Charles M. Schwab, American Society of Mechanical Engineers; Arthur W. Berresford, American Institute of Electrical Engineers; and George Gibbs, United Engineering Society.

R. N. Hunt Addresses Utah Section

The geology of Bingham ore deposits, productive of about $730,000,000 up to date, has three outstanding aspects, according to R. N. Hunt, chief geologist of the United States Smelting, Refining & Mining Company, who addressed the January meeting of the Utah section of the American Institute of Mining and Metallurgical Engineers at Salt Lake City. These are: First, the relation of the ores to three types of rock: quartzite, limestone, and porphyry, and the predominant occurrence of ores in the limestone; second, the importance of fissures in localizing the ores; and third, the zonal arrangement of copper and lead ores around a focal point, the Utah Copper stock.

"Actual statistics," said Mr. Hunt, "indicate the preferential replacement of limestone by ores. In a definite area about one mile square, actual computation shows that 6 per cent of the known volume of the ground is porphyry, 19 per cent, limestone and 75 per cent, quartzite. Of the 7,340,000 tons of ore less than 1 per cent came from situations enclosed by quartzite and porphyry.

"Fissures are important, in that they carry ores of width and grade suitable for mining and also localize the orebodies in the limestone. Fissures are of two predominating types: Northeast-southwest fissures dipping steeply either to the east or west, and east-west fissures, approximating both the strike and dip of the sedimentary formations.

"The most interesting feature of Bingham geology is the distribution of the lead and copper ores with respect to the Utah Copper stock, itself a low-grade copper orebody exploited by the Utah Copper company and estimated to contain over 700,000,000 tons of sulphide ore, carrying 1.1 per cent copper, including the 150,000,000 tons mined to date. In the limestones abutting this porphyry mass on three sides in the properties of the Utah-Apex, Utah Delaware, Utah Metals, United States, Montana Bingham and Bingham mines are copper replacement orebodies from which has come many millions of tons of ore characteristically associated with areas marked by intense alteration of the limestones and widespread pyritic mineralization. Many of these orebodies grade out into uncommercial masses of pyritic material in a gangue of lime-silicate minerals."

J. J. Beeson, consulting geologist of Salt Lake City, who recently returned from Colombia, gave a talk on the mineral resources of the South American republic.

David Levinger Addresses New York Section

Speaking before a meeting of the New York section of the American Institute of Mining and Metallurgical Engineers on Jan. 26, David Levinger, engineer of manufacture, Western Electric company, first outlined the organization of the engineering departments of the company, and then gave an interesting account of his observations made during a recent visit to many of the industrial centers of England and continental Europe. Two motion pictures, "Long Drawn Out," and another pertaining to the use of diamonds in wire drawing operations, both taken in the Hawthorne, Ill., plant of the company, were shown. A lively discussion, led by H. G. Moulton, who presided, followed, in which H. Foster Bain, G. H. Braman, Sidney J. Jennings, H. C. Jennison, Thomas T. Read, and Arthur L. Walker participated.

Appointment of the following nominating committee of the section was announced: H. DeWitt Smith, chairman; A. B. Parsons, Joseph E. Pogue, and A. T. Ward.

Personal Notes

LESTER W. STRAUSS, mining engineer of New York, has left Toronto for northern Ontario.

S. S. SMITH, mining engineer, has returned from Alaska to Oakland, Calif., where he will make his residence.

A. W. ALLEN has just returned to New York after visiting some of the important mines and cyanide plants of northern Ontario.

WILLIAM H. SELDEN, JR., has temporarily located at 74 Broadway, New York City. Mr. Selden's previous address was Iron River, Mich.

CHARLES W. NEWTON, general manager of the Callahan Zinc-Lead Company, of Wallace, Idaho, is in New York on business for his company.

A. JOHN EVELAND is now with Dwight P. Robinson & Company, Inc. He has gone to Buenos Aires to assist in subway construction there.

GEORGE H. GARREY, Philadelphia consulting engineer, has returned to the East after two months spent at the Piermont mine near Ely, Nev.

ROBERT I. KERR, until recently secretary of the California Metal and Mineral Producers' Association, and MRS. KERR left San Francisco on a world tour late in January.

MISS KATHLEEN RICE, the only woman prospector in Manitoba, has secured some promising claims in the Herb Lake area, in which copper and nickel have been discovered.

R. G. K. MORRISON, mining engineer, has accepted a position with the Ooregum Gold Mining Company, of Mysore, India. Mr. Morrison formerly had offices in Winnipeg, Manitoba.

CLARENCE THOM, formerly of the staff of the Consolidated Mining & Smelting Company, has been appointed assistant ore-dressing engineer for the U. S. Bureau of Mines at Moscow, Idaho.

H. Y. WALKER, recently elected vice-president of the American Smelting & Refining Company, and R. F. MCELVENNY, general manager of the western department, are making a tour of the company's plants.

EDMUND JUSSEN, mining engineer and geologist, has established his office at 430 California St., San Francisco, where he will specialize in general mining and geology as well as in shaft sinking and tunneling.

DAVID R. THOMAS has been appointed consulting engineer by the Laval-Quebec Mines, Ltd., which will at once begin operations on a group of copper claims in the Sudbury Basin of northern Ontario on which they have taken an option.

H. C. BELLINGER, vice-president of the Chile Copper Company, and W. D. B. MOTTER, his assistant, will sail for Chile early in February for a visit to the mines and plants of the company. They expect to be gone about two months.

C. L. PERKINS has resigned from the staff of the Metals Recovery Company to accept a position with the American Tar Products Company, of Pittsburgh, Pa. Mr. Perkins was research engineer for the Metals Recovery Company.

B. MARCUSE, of Montreal, for many years identified with the asbestos industry, has purchased control of the Canadian Asbestos Company, of that city. The Canadian Asbestos was established in 1897 and was one of the pioneer asbestos companies of Quebec.

HENRY C. CARLISLE has opened an office as consulting mining engineer at 315 Montgomery St., San Francisco. Mr. Carlisle has been made consulting engineer of the Tonopah Mining Company, of Nevada, but will devote much of his time to private practice.

THEODORE MEYERS, of London, England, representing the Solly Joel interests, which own extensive diamond properties in South Africa, is on a visit to Canada and will make an extensive tour of the mining regions with a view to the investment of British capital.

DR. W. G. WOOLNOUGH, announcement of whose appointment as geological adviser to the Australian Commonwealth, for a period of six months, was made in the Oct. 8, 1927, issue of *E. & M. J.*, has recently been confirmed as permanent in the position mentioned. A strike of filtered oil at Roma, Queensland, is, says Dr. Woolnough in a recent communication, "while by no means final and conclusive, most encouraging."

Dr. LOUIS D. RICKETTS and W. D. THORNTON have severed their connections with the Ahumada Lead Company and its subsidiary, the Erupcion Mining Company. Dr. Ricketts was president and director of both companies and Mr. Thornton was vice-president and director of the Ahumada. O. R. WHITAKER was elected to fill the places left vacant by Mr. Thornton in the Ahumada and by Dr. Ricketts in the Erupcion. The presidency of the Ahumada will be filled later.

LUCIEN EATON, superintendent of mines in the Ishpeming (Mich.) district for the Cleveland-Cliffs Iron Company, has been granted a leave of absence for four months and has departed for Russia, where he will inspect and report on iron mining properties for Stuart, James & Cooke, a New York engineering firm that is acting in a consulting capacity for the Soviet government. The properties to be examined are about 100 miles to the north of Odessa, on the Black Sea.

LESLIE URQUHART, chairman of directors of Russo-Asiatic Consolidated, Ltd., which has a controlling interest in Mount Isa Mines, Ltd., Queensland, arrived in Australia from London in January, on his way to the Mount Isa silver-lead mines. He was accompanied by DEANE P. MITCHELL, an American mining engineer, who at one time was general manager of the Zinc Corporation of Broken Hill; also by W. H. CORBOULD, advisory director of Mount Isa Mines, Ltd., who had been in England several months in connection with the affairs of that company.

HOMAR L. JOHNSON has joined the editorial staff of *Engineering and Mining Journal*. Mr. Johnson holds the degree of Engineer of Mines from the Colorado School of Mines and also attended Ohio University. He served with the United States Regular Army during the World War. His professional experience began with the Chief Consolidated Mining Company at Eureka, Utah, where he assisted in developing a flotation method of treatment for the refractory ores of that district. Since leaving Eureka, Mr. Johnson has been employed by the Western Reward Mining Company, Shoup, Idaho; Castle Creek Mining & Milling Company of Boise, Idaho; and the B & B Quicksilver Company, of Arlemont, Nev., having been superintendent of the last-named property.

OBITUARY

General GEORGE W. GOETHALS passed away in New York City on Jan. 22. The Panama Canal, in the building of which he took the most important part, is a monument to his genius. He was 69 years old.

WILLIAM DU PONT, a member of the family long noted in the manufacture of explosives, and at one time head of the organization bearing his name, died near Brunswick, Ga., on Jan. 20. Mr. du Pont was 73 years old. He is credited with the invention of a dynamite mixing machine.

BERTHOLD HOCHSCHILD, at one time chairman of the board of directors and president of the American Metal Company, died in New York on Jan. 24. Mr. Hochschild had not been actively engaged in mining affairs for some ten years prior to his death. He had been in bad health for two years.

JAMES FARRELL, pioneer Utah miner and banker, died recently at his Salt Lake home. Born in Ireland, May 24, 1843, Mr. Farrell came to Utah in his early thirties. A contract for hauling freight between the famous camp of Silver Reef to Pioche, Nev., marked Mr. Farrell's first connection with the mining industry. Later, Mr. Farrell acquired valuable ore hauling contracts at Park City, where he became president of the Quincy Mining Company and a director of the Park City First National Bank. He was also president of the First State Bank of Salina, a director of the National Copper Bank of Salt Lake City, and president of the Galigher Machinery Company when he died.

Market and Financial News

Coeur d'Alene Mines Have Produced $742,000,000

THE Coeur d'Alene mining district, Idaho, is credited with mineral production of $742,860,613 by statistics recently compiled from information obtained from official sources and careful estimates. This large total includes in the order of their importance: lead, silver, zinc, gold, and copper.

Beginning with the year 1902, when the law taxing the net profits of mining companies went into effect, all productive mining companies operating in Idaho were required to make annual statements under oath with the county assessor showing details of operation as a means of arriving at the net profit subject to taxation. According to these statements for 25 years beginning with 1902 and ending with 1926, the total gross value of ore produced was $456,020,034.

From 1884 down to 1902 there is no available record of mineral production of the district, but an estimate by the U. S. Geological Survey places it at $241,840,579. Reports for 1927 have not been filed, but the value was approximately $25,000,000. Other sources of production since 1902 not included in the official figures are leasing operations, shipments from mines in the development state, tailings mills, and placer gold mining, and the aggregate value of production from these sources is conservatively estimated at $20,000,000. Grand total, $742,860,613.

Statistics of Copper Production in 1926 and 1927

THE chart showing the production of copper in the different countries in the world during the last seven years, that appeared in connection with the excellent review of copper by Mr. T. Wolfson, in the recent Annual Review Number of the *E.&M.J.*, was not prepared by Mr. Wolfson, but by the editors. Mr. Wolfson points out that the chart indicates an increase in the production from the United States in 1927, whereas his article says that there was a decline. He is right with respect both to mine production, and to blister production from domestic ores. The discrepancy arose by using the figures in the yearbook of the American Bureau of Metal Statistics for the years up to and including 1926, and calculating the figures for 1927 from the monthly report of the Bureau for December, which covered the first eleven months. These are the only data available at this time. Whereas in the handbook figures credit the blister as far as possible to the country where the ore originated, figures in the monthly reports make no such attempt at such a segregation, and smelter production from some foreign ores is included. The blocks for both 1926 and 1927 as shown in the chart are correct taken individually; but the comparison made by considering them together is erroneous, because of the different methods of allocation used. Both are based on blister copper; and the world output increased as indicated. However, the distribution for 1927, to permit comparison with 1926, should have shown less from the United States and more from "other" countries.

HUDSON BAY MINING & SMELTING COMPANY is the name of a new corporation that will be formed to take over the Flin Flon properties in Manitoba recently acquired by the Harry Payne Whitney interests.

Imports and Exports of Ores and Metals in December, 1926 and 1927

Compiled from U. S. Department of Commerce Records
In Pounds Unless Otherwise Stated

Imports

	December 1926	December 1927
Antimony:		
Ore { Gross Weight	380,657	600,415
Ore { Antimony content	162,356	333,504
Liquated regulus or metal	2,050,772	1,501,364
Copper		
Ores, copper content	13,406,570	8,973,264
Concentrates, copper content	3,068,235	2,774,467
Regulus, coarse metal, cement copper	21,900	104,000
Imported from:		
Spain	493,267	167,809
Canada	7,448,659	3,227,463
Mexico	2,553,673	2,396,765
Cuba	.....	503,000
Chile	5,255,182	5,359,290
Peru	110,437	26,079
Other countries	635,487	171,325
Unrefined black, blister, converter Copper in pigs, bars, and other forms	25,480,280	38,522,248
Refined copper	19,967,921	3,197,537
Old and clippings for remanufacture	559,455	1,482,479
Composition metal, copper chief value	.....	.....
Brass		
Old and clippings for remanufacture	1,046,306	719,505
Lead		
Ore and matte, lead content	14,548,430	4,257,875
Bullion or base bullion	15,593,840	16,871,408
Pigs, bars, old and scrap	1,571,958	43,620
Babbitt, solder and other forms, lead content	299,420	103,166
Manganese		
Ore, tons { Cuba, manganese content	.....	920
Ore, tons { Other countries, manganese content	26,971	30,851
Pyrites, tons	16,773	7,507
Tin		
Ore, tons	10	7
Bars, blocks, pigs	14,299,815	8,865,998
Imported from:		
Netherlands	1,909,581	1,176,983
United Kingdom	4,606,471	1,670,761
British Malaya	6,532,711	5,722,677
Netherland East Indies	.....	69,975
Hongkong	380,890	100,900
Australia	268,800	67,200
Other countries	601,362	57,502
Zinc		
Ore, zinc content { Free	.....	.....
Ore, zinc content { Dutiable	2,001,615	247,960
Blocks, pigs and old	3,319	67,196

Exports

	December 1926	December 1927
Copper		
Ores, composition, concentrates, unrefined	238,188	903,137
Refined copper in ingots and other forms	85,081,129	90,586,826
Exported to:		
Canada	811,395	221,039
Belgium	7,850,525	9,492,652
France	16,184,810	12,523,595
Germany	18,520,773	20,486,425
Italy	6,332,361	6,897,225
Netherlands	6,096,598	12,572,912
Spain	156,562	381,457
Sweden	2,139,730	1,539,248
United Kingdom	20,994,613	18,327,406
Other Europe	1,177,110	6,473,289
British India	280,602	224,257
China, Honkong and Kwantung	1,230,506	.....
Japan	3,092,600	896,180
Other countries	212,944	551,141
Old and scrap	2,615,525	5,220,982
Pipes and tubes	319,037	166,323
Plates and sheets	800,629	245,736
Rods	4,399,617	5,581,828
Wire	647,723	841,305
Insulated copper wire and cable	1,270,046	1,514,656
Lead		
In pigs, bars and other forms	15,760,623	21,784,650
From domestic ore	1,088,539	600,112
From foreign ore	14,672,084	21,184,538
Exported to:		
France	168,031	784,185
Germany	5,153,346	6,217,634
Netherlands	112,058	1,310,913
Sweden	470,620	1,008,271
United Kingdom	2,856,766	6,743,352
Other Europe	225,103	77,926
Brazil	56,016	20,541
Other South America	1,661,038	854,418
China, Hongkong and Kwantung	784,795	281,061
Japan	4,235,095	2,464,768
Other countries	37,755	46,201
Other lead manufactures	1,698,983	934,298
Zinc		
Ores and concentrates, tons	1,710	1,909
Dross	397,790	500,002
Cast in slabs, blocks and pigs	8,098,216	2,083,008
Exported to:		
Belgium	336,128	56,000
France	571,134	517,642
Germany	493,005	336,037
Italy	224,033	.....
Netherlands	804,107	175,229
United Kingdom	3,753,755	168,027
Other Europe	313,618	67,200
Japan	112,004	728,184
Other countries	1,490,432	34,689
Sheets, strips, other forms	584,669	594,742
Dust	196,275	288,094
Other zinc manufactures	373,850	245,152

The Market Report

Metal Markets Quiet but Steady

New York, Feb. 1, 1928—Buying of non-ferrous metals in the week ending today has been small, but prices are little changed from those obtaining last Wednesday in the domestic market. Copper had been dull until today when an incipient buying wave started. A moderate business was done in both lead and zinc, prices for the former tending to weaken as a consequence of material declines in London, while zinc became slightly firmer. Both buyers and sellers appear to be marking time. One man describes the situation by saying that there is a "hang-over" of year-end dullness that should end at any time. Antimony is firmer; quicksilver is easier. Although first-hands are holding at the recently improved prices for metals of the platinum group, speculative lots in considerable aggregate quantity are obtainable at concessions.

Daily Prices of Metals

Jan. Feb.	Copper	Tin		Lead		Zinc
	Electrolytic, N. Y.	99 Per Cent	Straits	N. Y.	St. L.	St. L.
26	13.875@13.90	54.50	54.875	6.50	6.25@6.275	5.65@5.675
27	13.875@13.90	55.125	55.50	6.50	6.25	5.675
28	13.875@13.90	55.125	55.50	6.50	6.25	5.65@5.675
30	13.875@13.90	54.25	54.75	6.50	6.25	5.675@5.70
31	13.85 @13.90	54.125	54.625	6.50	6.25	5.675
1	13.90	53.875	54.25	6.50	6.25	5.65@5.675
	13.888	54.500	54.917	6.500	6.252	5.671

Average prices for calendar week ending Jan. 28, 1928, are: Copper, 13.881; 99 per cent tin, 55.021; Straits, 55.396; N. Y. lead, 6.500; St. Louis lead, 6.267; zinc, 5.656; and silver, 56.646.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; i.e., delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for ordinary form of wire bars, ingot bars, and cakes. For ingots an extra 0.05c. per pound is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.13c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Jan. Feb.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
26	62½	62⅛	66¾	250½	250	21⅝	22 1/16	26 7/16	26⅜
27	62 7/16	62 1/16	66½	251	250¼	21½	21 15/16	26⅜	26 5/16
30	62 11/16	62⅛	66½	249¾	249½	21⅛	21⅝	26¼	26¼
31	62 13/16	62¼	66½	247⅜	247½	21 13/16	21 5/16	26⅜	26 1/16
1	62¾	62 3/16	66½	245¾	245¾	20⅞	21⅜	26	26

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Jan.	Sterling Exchange "Checks"	Silver		Gold London	Jan. Feb.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
26	4.87⅛	56½	26 1/16	84s11½d	30	4.86⅞	57⅛	26¼	84s11½d
27	4.86¾	56¼	26⅛	84s11½d	31	4.86 9/16	56¾	26¼	84s10¾d
28	4.86⅞	56⅞	26¼	.....	1	4.86⅝	56⅝	26⅛	84s11¼d
					Avg.		56.771		

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Average Medal Pices for January, 1928

COPPER:	
New York Elcetrolytic	13.854
London Standard Spot	61.912
London Electrolytic Spot	66.557
LEAD:	
New York	6.500
St. Louis	6.280
London Spot	21.773
London Forward	22.213
SILVER:	
New York	57.135
London	26.313
Sterling Exchange	487.098
ZINC:	
St. Louis	5.643
London Spot	26.125
London Forward	26.051
TIN:	
99 per cent	55.180
Straits	55.650
London	253.222
QUICKSILVER	123.620
ANTIMONY	10.863
PLATINUM:	
Refined	79.280
Crude	69.280
ALUMINUM, 98 PER CENT	24.300

Copper at 14.125c

This afternoon wire-drawing interests entered the copper market rather unexpectedly and bought about 5,000,000 lb. of copper at 14.125c., delivered in Connecticut. These sales were distributed among several sellers and in the aggregate formed a considerable proportion of the business of a comparatively dull week.

Primary producers have continued to stand pat at the 14.125c. price, Connecticut. Moreover, they have made sales at that figure each day during the week; and business has been done on Monday and Tuesday at so-called Middle West points at 14.25c. and even a little higher. On the other hand, one or two customs smelters have shaded the even eighth by from 2½ to 5 points. Incidentally, two interests that come under this classification have been firm at 14.125c. Foreign copper business at 14.50c. c.i.f. has been fair, the total for the month of January being about 45,000 tons. This business has helped take the pressure off the domestic sellers. Brass fabricators are doing a little better than they did earlier in January and the impression is general that their customers are placing more orders, and that further improvement in this particular is to be expected soon.

Zinc at 5.65@5.675c.

Modest sales of zinc have been made at prices ranging from 5.65c. to 5.70c. with April-May delivery commanding a small premium over prompt. Ore prices were advanced in Joplin, and with some curtailment in effect the tone of the slab-zinc market is a little better. Producers are disinclined to press metal, but at the same time consumers are not very hungry for it, judging from the slack inquiry. An accasional car of High-Grade is sold in New York on the basis of 7.75c.

London Drop Worries Lead Sellers

Lead business was fairly good until Monday, when the continued decline in London caused buyers to wonder if a reduction in prices on this side was not in order, so for the last three days the market has been very quiet indeed. The slight advance in London today probably prevented any weakening by domestic sellers; the American Smelting & Refining Company continues its contract price at 6½c., New York, and other sellers quote on the same basis, though perhaps shading differentials slightly on sales to other consuming centers.

Lead has been freely offered in good tonnages all week at 6¼c., St. Louis. Most of the aggressiveness has come from dealers, though producers have also sold on the same basis. One of the leading producers, however, continues a little above this level, content to sell only an occasional carload, or take average price business.

Corroding grades command the usual premium of $2 to $3 a ton.

Tin Quiet and Lower

The tin market continues quiet, with daily sales in the neighborhood of 200 tons. Though prices have declined slightly from those of a week ago, the drop has not been sufficient to stimulate much buying. The 99 per cent grade is practically out of the market, and quotations are only nominal, as, based on 100 per cent tin, it is held at prices above those for Straits. Only small lots of German and English 99 per cent tin are offered. Forward Straits has sold at practically the same prices as those asked for spot.

Exchanges Slightly Lower

Foreign exchanges are slightly weaker. Closing cable quotations on Tuesday, Jan. 31, were: Francs, 3.92$\frac{13}{16}$c.; lire, 5.295c.; marks, 23.83c. Canadian dollars, $\frac{1}{4}$ per cent discount.

Silver Steady

Purchases by China have been the cause of the steady advance in the silver market to Jan. 30, but owing to the reversal of her position prices have since declined. The market closes steady at the lower level, although India does not seem interested at present.

Mexican Dollars (old Mexican pesos): Jan. 26th, 43⅛c.; 27th, 43⅜c.; 28th, 43½c.; 30th, 43⅝c.; 31st, 43⅜c.; Feb. 1st, 43¼c.

Zinc Ore Production Low

Joplin, Mo., Jan. 28, 1928

Blende	Per Ton
High	$41.10
Premium blende, basis 60 per cent zinc	$38.00@ 39.00
Prime Western, basis 60 per cent zinc	37.00
Slimes and fines, 60 per cent zinc	34.00@ 36.00
Average settling price, all zinc	37.64
Galena	
High	$88.30
Basis 80 per cent lead	$85.00@ 90.00
Average settling price, all lead	85.65

Shipments for the week: Blende, 11,746; lead, 2,038 tons. Value, all ores the week, $616,760.

Shipments for the month: Blende, 37,190; lead, 7,433 tons. Value, all ores the month, $2,022,270.

Production and purchase of zinc ore have balanced closely all month, the average of each being around 10,000 tons per week. Shipments, however, have averaged less than 9,300 tons per week, and that is not enough ore to supply the number of retorts in operation.

Platteville, Wis, Jan. 28, 1928

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$38.75
Lead Ore	
Lead, basis 80 per cent lead	$85.00

Shipments for the week: Blende, 670 tons; lead, 80 tons. Shipments for the year: Blende, 2,728; lead, 240 tons. Shipments for the week to separating plants, 1,277 tons blende.

Correction—The quotation for zinc blende under the Platteville date of Jan. 21 in the issue of Jan. 28 should have been $38.75 per ton. Through a misprint it appeared as $38.15.

Iron and Steel Trade

Pittsburgh, Feb. 1, 1928

January brought what may be called the usual seasonal increase in steel demand and production, auguring neither better nor worse conditions for 1928 as a whole than prevailed in 1927. The month's ingot production, at 15 to 20 per cent above the December rate, was approximately equal to that of January, 1927, and some 10 per cent under that of January, 1926. Prospects are for further seasonal increases, at a moderate pace.

Steel mills are making more serious efforts than formerly to secure better prices, having concrete evidence of the necessity in the substantial decreases shown by earnings reports from 1926 to 1927 and marked further decreases for the fourth quarter of 1927. Advances are likely in bars, shapes, plates, sheets, strips, and wire products if all goes well, there being the familiar delays while old obligations are being worked off. Buyers show resistance, chiefly because they must sell in their turn, and have marketing difficulties of their own.

The automobile industry is slowly increasing its operations. The agricultural implement industry continues operating at a very high rate. Fabricated structural steel promises to do fully as well in 1928 as in recent years. Railroad purchases involving steel are likely to be slightly heavier.

The pig iron, coke, and scrap markets continued very dull throughout January, with no significant price changes.

Iron—Per gross ton, Valley furnaces: Bessemer, $17.50; basic, $17; No. 2 foundry, $17.25.

Steel—Base prices per gross ton, Pittsburgh, billets and slabs, $33; structural shapes, plates, and soft steel bars, 1.80@1.85c. per lb. Black sheets firm at 2.90c.

Coke—Per gross ton, Connellsville furnace, contract, $2.85@$3; spot, $2.60@$2.75. Connellsville foundry, spot and contract, $3.75@$4.25. By-product coke, Ohio, and Kentucky, $7.50; Buffalo and Detroit, $9.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., 98 or 99 per cent grades, price of leading interest, 24.30c.; outside market, 23.90@24.30c. London, 98 per cent, quoted at £104@ £107 per long ton for domestic consumption. Largely nominal.

ANTIMONY—Per lb., duty paid, spot: Chinese brands, 10⅞@11¼c., range for week. Market quiet. Cookson's "C" grade, spot, 16⅜c.

Chinese needle, lump, 8c. Standard powdered needle, 200 mesh, 10c. White oxide, Chinese, 99 per cent Sb_2O_3, 15½c. Nominal.

BISMUTH—Per lb., in ton lots, $1.85@ $2.10. London, 8s. Domestic market continues below London parity.

CADMIUM—Per lb., 60c. London, 1s. 11d. for Australian metal.

COBALT—Per lb., f.o.b. Canadian works: Shot, 96@98 per cent, $2.50. Black oxide, 70 per cent, $2.10. London, 9½@10s. for metal; 8s. for black axide; 8s. 10d. for gray.

[1]GERMANIUM OXIDE—Per gram in 300- to 500-gram lots, $5.

IRIDIUM—Per oz., $390@$415 for 98 @99 per cent sponge and powder. Little metal available.

[1]LITHIUM—Per oz., 98@99 per cent grade in 1- to 5-lb. lots, $1.55.

MAGNESIUM—Per lb., in ton lots: 8-lb. ingots (3x3x16 in.), 98c.; 3-lb. sticks (1⅜x33 in.), $0.95@$1; 10-oz. sticks (1x12 in.), 85@90c. Market quiet. London 3s. 9d.@4s. 3d. for 99 per cent ingots or sticks.

[1]MOLYBDENUM—Per gram, 99 per cent, 2½c.; chemically pure metal, 8c. (Usually sold as calcium molybdate or ferromolybdenum, which see).

MONEL METAL—Per lb. base price for shot, 28c., f.o.b. Huntington, W. Va.

NICKEL—Per lb., ingot, 35c.; shot, 36c.; electrolytic, 37c. (99.90 per cent grade), for single lots of spot metal. Good demand. London, per long ton, £170@£175 according to quantity. Business fair.

OSMIUM—Per oz., $80@$85; London, £14@£16½.

PALLADIUM—Per oz., $49.50@52.50. Small lots bring up to $56. London £10¼@£11½. Nominal.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $85. Dealers and refiners quote the trade for refined metal, per oz., $82@ $85, cash. Speculative lots are to be had at $80. Market much quieter after moderate activity of recent weeks.

[1]Price furnished by Foote Mineral Co., Philadelphia.

London, per oz., £14@£14¼ for refined; crude and scrap, nominal.

QUICKSILVER — Per 76-lb. flask, $122.50@$123.50. Market quiet. San Francisco wires $127.33. London firm at £22 8d.

RADIUM — Per mg. radium content. $70.

RHODIUM—Per oz., $60@$65; London, £9½@£11½. Nominal.

RUTHENIUM — Per oz., $70@$75. Nominal. London, £6@£8½.

[1]SELENIUM—Per lb. in ton lots; Black, powdered, amorphous, 99.5 per cent pure, $1.90@$2. London, 7s. 8d. @7s. 9d.

TANTALUM — Per gram: Bar and heavy sheet, chemically pure, 20c.; tantalum powder, 12c. Nominal.

TELLURIUM—Per oz., 12½c.

[1]THALLIUM METAL—Per oz.: Ingot, 99 per cent pure, 95c. in 25-lb. lots.

TUNGSTEN POWDER — Per lb. contained tungsten, 97 to 98 per cent pure, $0.95@$0.98.

[1]ZIRCONIUM METAL—Per oz., 98 per cent grade, 95c. in 5- to 10-lb. lots.

Metallic Ores

CHROME ORE—Per long ton, f.o.b. Eastern shipping points, $22.50@$23 for 45 to 50 per cent Cr_2O_3 ore. Prices firm.

IRON ORE—Per long ton, lower Lake ports. Lake Superior ores.

Mesabi, non-bessemer, 51½ per cent iron, $4.25. Old Range, $4.40.

Mesabi, bessemer, 51½ per cent iron, $4.40. Old Range bessemer, 51½ per cent, $4.55.

Eastern ores, cents per unit, delivered at furnaces: Foundry and basic, 58 to 63 per cent, 8@8½c.

Foreign ores, f.o.b. cars Atlantic ports, cents per unit:

North African, low-phosphorus, 11 @11½c., nominal.

Spanish foundry or basic, 50@54 per cent, 8½@9c. Nominal.

Swedish foundry or basic, 66@68 per cent, 9@9½c.

MANGANESE ORE—Per long ton unit of Mn, c.i.f. North Atlantic ports, minimum 47 per cent Mn, 35@38c. Caucasian (washed), 53@55 per cent, 38.50@40c.

Per ton in carload lots:

[1]Chemical grades, powdered, coarse or fine, 82@87 per cent MnO_2, Brazilian and Cuban, $70@$80. Domestic, 70 to 72 per cent, $40@$50.

TANTALUM ORE—Per unit of Ta_2O_5, basis 65 per cent ore, $13.

TITANIUM ORE—Ilmenite, per gross ton, 52 to 60 per cent TiO_2, f.o.b. Atlantic seaboard, $9.50@$11, according to grade and impurities. Low-grade domestic, 32 to 35 per cent, about $7@$8 per gross ton. Rutile, per lb., 96 per cent concentrate, 11c. to 13c.

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Wolframite, $10.25@$10.50. Western scheelite, $10.40@$10.65. Market dull, prices largely nominal.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.

[1]AMBLYGONITE—Per ton, f.o.b. mines: 8@9 per cent lithium oxide, $50@$60.

ASBESTOS—Per ton: f.o.b. Quebec mines, tax and bags included, prices quoted by leading interest:

Crude No. 1, $650; crude No. 2, $400 @$500; spinning fibers, $200@$225; magnesia and compressed sheet fibers, $160@$175; shingle stock, $65@$115, various grades; paper stock, $45@$50; cement stock, $25; short fibers, $10@ $20; floats, $15. Market very active for all grades above shingle stock. Prices on brake lining recently advanced 10 per cent by large interests.

Per ton c.i.f. New York: Rhodesian crude No. 1, $450; No. 2, $350.

BARYTES—Per long ton: f.o.b. mines, bags extra:

Georgia: Barytes ore, crude, $7. Wet ground, off color, $12@$18, depending on analysis. Shipments steady; production about 70 per cent of "normal."

Missouri: Water ground and floated, bleached, $23; $25 in less than car lots, f.o.b. works. Crude ore, 93 per cent $BaSO_4$, not to exceed 1 per cent iron, per ton, $7.50, f.o.b. mines. Market fair.

BAUXITE — Per long ton: No. 1 chemical ore, over 60 per cent Al_2O_3, less than 5 per cent SiO_2, and less than 2 per cent Fe_2O_3 $8, f.o.b. *Georgia* mines. Pulverized and dried $14; calcined $18@$20.

Per metric ton, foreign, c.i.f.: Dalmatian, low SiO_2, $5@$6.50; Istrian, $5.50@$7; French, red, $6@$7.50.

BORAX—Per lb.: Carload lots, in bags, crystals, 4c.; granulated or powdered, 3¾c.; f.o.b. plant, Pennsylvania. Keen competition in market.

[1]CELESTITE—Per ton in carload lots: 90 per cent $SrSO_4$, finely powdered, $27.

CHALK—Per ton: Crude in bulk, c.i.f. *New York*, $4.75@$5.

CHINA CLAY (KAOLIN)—Per ton: F.o.b. *Virginia* mines, crude lump, No. 1, $7; crude No. 2, $5.50; washed, $8; powdered and air-floated, $10@$15; ground, $7@$10.

Florida, pressed pottery, bulk, $13; ground, No. 1, $20; No. 2, $15. Sprayed mineral flour No. 1, $20; No. 2, $17. Market fair.

Best grade, domestic, $16@$18, f.o.b. *Delaware* plants in carload lots.

Imported English, f.o.b. American ports: Lump, $13@$21; powdered, $45@$50.

DIATOMITE — Per short ton, f.o.b. plant:

Kiln-fired brick, $65; kiln-fired aggregate, ¼ in., $45; insulating powder, $25; natural aggregate, ¼ in. $20; air-floated powder, $45. Over 85 per cent silica, 98 per cent through 200 mesh, $25@$26, depending on quantity. Market fair to good.

EMERY — F.o.b. *Pennsylvania* and *New York* in 350-lb. kegs, per lb.: Greek Naxos, 6½c.; Turkish, 6½c.; Khasia, 5½c.; domestic, 3½c. Market good.

FELDSPAR—F.o.b. mine or grinding plant:

North Carolina, per long ton, No. 1 pottery grade, crude, $6@$7.50. Demand fair.

New Hampshire, per ton: Pottery grade, $8.50. Best quality lump, $9. Market good.

New York, Per ton: f.o.b. cars, No. 1 crude, $9. Market very quiet.

Tennessee, per ton: No. 1, pottery, 140 mesh, $16; 200 mesh, $18. No. 2, enamel, 140 mesh, $13.75; 200 mesh, $15.50; demand improving at steady prices.

Maine, per ton: Best pottery grade, ground, $19. Market good.

FLUORSPAR—Per ton: F.o.b. *Kentucky* and *Illinois* mines.

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $14.50@$15. Quiet. Foundry lump, 85-5, $17. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $32.50 in bulk; $36.50 in bags or barrels. Acid lump, 98-1, $30 in car lots. Prices for 85-5 are about $1 lower. Overproduction is assigned as the reason for weakness in prices.

New Mexico: 85-5 gravel, $16.50; 85-5 lump, $16.50; 90-4 lump, $19.50; 96-3 ground, 100 mesh, $32.50, bulk. Market fair; production steady.

Foreign spar, duty paid, $15.50@$16, tidewater.

FULLER'S EARTH — Per ton, f.o.b. *Florida:* 16 to 30 mesh, $16.50; 30 to 60 mesh, $18; 60 to 100 mesh, $14; 100 mesh up, $8; 200 mesh up, $14. Market fair at unchanged prices.

Powdered, import duty paid, $24@ $25 per ton.

GARNET — Per ton; domestic, f.o.b. mines, $85. Market easy.

Spanish grades, $60, c.i.f. port of entry.

GILSONITE — Per ton, carload lots, f.o.b. mines *Colorado:*

Selected grade, $33; seconds (mine run), $25.50.

GRAPHITE — Per ton: F.o.b. *New York.*

Ceylon lump, 8@8½c.; chip, 7@7½c.; dust, 3@5½c.; Madagascar flake, 7@7½c. Market fair.

No. 1 flake, 8c. and up. Foundry facings, 3c. and up. Amorphous and crystalline, fine ground, 3c. and up. Crude amorphous graphite, $15@$35 per ton, according to grade.

GREENSAND—Per ton, f.o.b. cars, *New Jersey:* Screened and bagged, best grade in carload lots, $25. More inquiries indicate better business.

[1]Price furnished by Foote Mineral Co., Philadelphia.

GYPSUM—Per ton, f.o.b. mill, depending upon location: Crushed, $2.75@$3; ground, $4@$8; agricultural, $6@$10; calcined, $8@$10.

IRON OXIDE (See Ocher)—Per lb.: Standard Spanish red, 2½@4½c.; domestic earth, 2@4½c.

KAOLIN—See China Clay.

[1]LEPIDOLITE—Per ton: $20@$30 for ordinary grades. Nominal.

LIMESTONE—Per ton: f.o.b. shipping points, depending on location, either lump or crushed, 75c.@$2.

Agricultural, $1 up to $4 or $5 for crushed or pulverized. Prices depend upon source, purity, and fineness.

MAGNESITE — Per short ton, f.o.b. *California* mines: Grade "A" calcined, 80 per cent through 200 mesh, $40; grade B, $38; dead burned, $30@$32; crude, $14. F.o.b. Eastern seaboard, calcined, $40.

MICA—Per ton, f. o.b. plant:

New Hampshire: Mine run, $300; clean shop scrap, $25; mine scrap, $22. White dry ground, 20 mesh, $25; 40 mesh, $40; 60 mesh, $65; 100 mesh, $80; 200 mesh, $100. Market fairly active and somewhat firmer.

North Carolina: White, ground, 20 mesh, $35; 70 mesh, $100.

Madagascar, amber, dark, free from iron, per lb., f.o.b. *New York*, duty paid: No. A1, $3.50@$4; No. 1, $3; No. 2, $2.50; No. 3, $1.30; No. 4, 70@80c.; No. 5, 45c. Market strong.

[1]MONAZITE—Per ton: (Minimum 6 per cent ThO_2), $120.

OCHER — F.o.b. *Georgia* mines, per ton: $19@$20 in sacks; $21@$22 in barrels; washed and water floated, $18; second grade, 99 per cent through 225 mesh, $18. Market fair.

PHOSPHATE—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7; 75 per cent, $6.25; 74@75 per cent, $6; 70 per cent, $4.50; 68 per cent, $4.10; 66 per cent, $4. Prices firm.

Florida, pebble, domestic: 76@77 per cent, $6; 74@75 per cent, $5; 72 per cent, $4; 70 per cent, $3.50. Market fair.

Tennessee, ground, 97 per cent through 200 mesh, 33 per cent P_2O_5, $9.40 per ton. Brown lump for acid manufacture, per gross ton, $5.50 on 75 per cent basis; $4.50 on 72 per cent basis.

POTASH—The ruling contract prices are as follows:

	Bags	Bulk
Muriate of potash 80 @ 85 per cent, basis 80 per cent....	36.40	34.80
Sulphate of potash 90 @ 95 per cent, basis 90 per cent....	47.30	45.70
Sulphate of potash-magnesia 48 @ 53 per cent, basis 48 per cent	27.25	25.65
Manure salt 30 per ent.....	21.75	18.75
Manure salt 20 per cent.....	15.40	12.40
Kainit 14 @ 16 per cent.....	12.50	9.50
Kainit 12.4 per cent.....	12.00	9.00

Two thousand pounds net weight, c.i.f. Atlantic and Gulf ports. German weights, tares and analyses.

PUMICE STONE—Per lb : In barrels, powdered, 2½@4c.; selected lump, 5@7c.

PYRITES—Per long ton unit of sulphur: Tharsis, c.i.f. U. S. ports; guaranteed 48 per cent sulphur, furnace size, 2½-in. diameter, 13¼@13¾c. Same price for fines screened through ½-in. mesh. Cinder from ore to remain property of buyers. Good inquiry but few orders.

[1]QUARTZ ROCK CRYSTALS—Per lb. in ton lots: Colorless, clear but flawed, pieces ¼ to ½ lb. in weight, 40c. For optical purposes, double above prices; larger crystals still higher.

SILICA—Per ton: Water ground and floated, in bags, f.o.b. Illinois: 400 mesh, $31; 350 mesh. $26; 250 mesh, $18. Market quiet. Glass sand, f.o.b. producing plant, 75c.@$5 per ton; molding sand, 65c.@$3.50; blast sand, $1.35 @$3.50.

[1]SPODUMENE — Per ton: $20@$30, depending upon lithium content. Nominal.

SULPHUR—Per ton for domestic market, $18, f.o.b. Texas mines; $22 for export, Atlantic ports. Prices in reality are on a c.i.f. basis, but the average price reduced to an f.a.s. figure is about as given. Good shipment against contracts. Open prices $1 higher than above.

TALC—Per ton, carload lots, f.o.b. works, containers included:

Vermont: 99 per cent through 200 mesh, extra white, $9.50@$10.50; 99 per cent through 200 mesh, medium white, $8.50@$9.50; packed in 50-lb. paper bags. Most contracts for 1928 have been closed. Tonnage promises to be as large or a little larger than for 1927.

New York: Double air-floated, 200 mesh, $13.75; 325 mesh, $14.75. Demand good.

Georgia: Powdered, gray, $7.50@ $10; yellow, $9@$12; red, $11@$13; roofing, $7.50@$9. Market fair.

New Jersey: Soapstone, ground, $10 @$12; market fair.

TRIPOLI—Per short ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri:* Once ground through 40 mesh; rose and cream colored, $14. Double ground through 110 mesh; rose and cream, $17. Air-floated through 200 mesh, rose and cream, $25; mill run, $15. Business seasonally quiet.

[1]ZIRCON—Per lb., f.o.b. mines in carload lots: 95 per cent, 3c.

Metallic Compounds

ARSENIOUS OXIDE (White arsenic)—Per lb. 4c. Quiet. London, per long ton, £17¾@£18 for Cornish white.

CALCIUM MOLYBDATE OR MOLYTE — Per lb. of contained Mo, 95c., delivered.

COPPER SULPHATE (Blue Vitriol)—Per lb. in car lots, 5@5.10c., for either large or small crystals.

[1]Price furnished by Epote Mineral Co., Philadelphia.

SODIUM NITRATE—Per 100 lb.; crude, in bags ex vessel, Atlantic ports, $2.35 for spot; future delivery, $2.35.

SODIUM SULPHATE (Salt Cake)—Per ton, bulk, f.o.b. works, $17@$20.

ZINC OXIDE—Per lb. in bags, in car lots: Lead-free, 6½c.; 10, 20 or 35 per cent leaded grades, 6⅝c.; French red seal, in bags, 9⅜c.

Ferro-Alloys

[1]FERROCERIUM—Per lb., $5.50.

FERROCHROME—Per lb. of contained chromium, 60@70 per cent chromium, 4 to 6 per cent carbon, 10½@11c.

FERROMANGANESE — Per gross ton furnace: Domestic and foreign, 78@82 per cent, $100, for first quarter of 1928. Spiegeleisen, 19@21 per cent, $30@$32 on carload business, f.o.b. furnace. Market dull.

FERROMOLYBDENUM—Per lb. of Mo, f.o.b. shipping point, 50@60 per cent Mo, $1.

FERROPHOSPHORUS—Per ton, 18 per cent P, $91; electrolytic, 24 per cent, $122.50; f.o.b. *Alabama* and *Tennessee*.

FERROSILICON—Per gross ton, f.o.b. works, freight allowed on carload lots east of Mississippi River: 50 per cent, $83.50; 75 per cent, $130; 14@17 per cent, $45. Market fairly active.

FERROTITANIUM—Per ton: For 15 to 18 per cent material, $200, f.o.b. Niagara Falls, N. Y.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, 92@94c., f.o.b. works.

FERROVANADIUM—Per lb. of V contained, f.o.b. works, $3.15@$3.65, depending on grade and quantity. Market good.

Metal Products

ROLLED COPPER—Sheets, 22¾c.; wire, 16@16¼c. per lb., f.o.b. mill.

LEAD SHEETS—Full rolled 10c. per lb.; clipped 10¼c.

NICKEL SILVER—29¼c. per lb. for 18 per cent nickel Grade A sheets.

YELLOW (MUNTZ) METAL—Dimension sheets, 19¾c. per lb.; rods, 16¾c. per lb.

ZINC SHEETS—10c. per lb., f.o.b. works.

Refractories

CHROME BRICK—Per net ton, f.o.b. shipping point, $45.

FIRECLAY BRICK — Per M.: First quality, $43@$46, *Ohio, Kentucky, Central Pennsylvania;* second quality, $35 @$38.

MAGNESITE BRICK—Per net ton, f.o.b. works: 9-in. straights, $65.

SILICA BRICK—Per M., *Pennsylvania* and *Ohio*, $43; *Alabama*, $51; *Illinois*, $52.

[1]ZIRKITE—Per lb.: Powdered, 80 per cent ZrO_2, 3c. Brick, straights, 80c.@ $1 each.

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London Spot		Sterling Exchange	
	1927	1928	1927	1928	1927	1928
January	55.795	57.135	25.863	26.313	484.775	487.098
February	57.898	.....	26.854	.....	484.551	.....
March	55.306	.....	25.655	.....	484.887	.....
April	56.399	.....	26.136	.....	485.178	.....
May	56.280	.....	26.072	.....	485.288	.....
June	56.769	.....	26.203	.....	485.183	.....
July	56.360	.....	25.983	.....	485.145	.....
August	54.718	.....	25.224	.....	485.546	.....
September	55.445	.....	25.565	.....	485.878	.....
October	56.035	.....	25.776	.....	486.533	.....
November	57.474	.....	26.526	.....	486.956	.....
December	57.957	.....	26.701	.....	487.714	.....
Year	56.370	.....	26.047	.....	485.636	.....

New York quotations, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York Electrolytic		London Spot Standard		London Spot Electrolytic	
	1927	1928	1927	1928	1927	1928
January	12.990	13.854	55.414	61.912	62.375	66.557
February	12.682	.....	54.438	.....	61.119	.....
March	13.079	.....	55.935	.....	62.641	.....
April	12.808	.....	55.056	.....	61.526	.....
May	12.621	.....	54.563	.....	60.881	.....
June	12.370	.....	54.030	.....	59.881	.....
July	12.532	.....	54.551	.....	60.089	.....
August	12.971	.....	55.364	.....	62.227	.....
September	12.940	.....	54.455	.....	61.830	.....
October	12.958	.....	55.119	.....	62.256	.....
November	13.319	.....	58.830	.....	63.761	.....
December	13.774	.....	60.078	.....	66.181	.....
Year	12.920	.....	55.653	.....	62.064	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London			
	1927	1928	1927	1928	1927 Spot	1927 3 Mos.	1928 Spot	1928 3 Mos.
January	7.577	6.500	7.392	6.280	27.485	27.786	21.773	22.213
February	7.420	.....	7.286	.....	27.344	27.781	.....	.....
March	7.577	.....	7.328	.....	27.845	28.302	.....	.....
April	7.126	.....	6.807	.....	26.546	27.053	.....	.....
May	6.616	.....	6.269	.....	25.054	25.526	.....	.....
June	6.414	.....	6.150	.....	24.438	24.750	.....	.....
July	6.344	.....	6.120	.....	23.491	23.932	.....	.....
August	6.681	.....	6.367	.....	23.119	23.540	.....	.....
September	6.297	.....	6.044	.....	21.446	21.994	.....	.....
October	6.250	.....	6.013	.....	20.479	20.946	.....	.....
November	6.259	.....	6.035	.....	20.889	21.318	.....	.....
December	6.504	.....	6.319	.....	22.163	22.441	.....	.....
Year	6.755	.....	6.511	.....	24.192	24.614	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York		London			
	1927 99%	1928 99%	1927 Straits	1928 Straits	1927 Spot	1928 Spot
January	64.785	55.180	66.415	55.650	297.804	253.222
February	66.528	.....	69.142	.....	306.125	.....
March	67.833	.....	69.199	.....	313.315	.....
April	66.069	.....	67.933	.....	302.572	.....
May	63.935	.....	67.510	.....	294.938	.....
June	64.226	.....	67.466	.....	296.006	.....
July	62.625	.....	64.110	.....	288.690	.....
August	63.523	.....	64.431	.....	293.193	.....
September	60.735	.....	61.490	.....	280.432	.....
October	57.560	.....	58.450	.....	264.631	.....
November	57.089	.....	57.641	.....	262.591	.....
December	58.053	.....	58.452	.....	267.138	.....
Year	62.747	.....	64.353	.....	288.953	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1927	1928	1927 Spot	1927 3 Mos.	1928 Spot	1928 3 Mos.
January	6.661	5.643	30.979	30.938	26.125	26.051
February	6.673	.....	29.931	30.109	.....	.....
March	6.692	.....	30.649	30.889	.....	.....
April	6.338	.....	29.579	29.901	.....	.....
May	6.075	.....	29.034	29.131	.....	.....
June	6.213	.....	28.598	28.613	.....	.....
July	6.229	.....	28.280	28.021	.....	.....
August	6.342	.....	28.210	28.068	.....	.....
September	6.212	.....	27.347	27.327	.....	.....
October	5.996	.....	26.899	26.634	.....	.....
November	5.745	.....	26.281	26.006	.....	.....
December	5.722	.....	26.363	26.109	.....	.....
Year	6.242	.....	28.513	28.479	.....	.....

St. Louis quotations, cents per pound. London pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) Refined New York		Platinum (c) Crude New York	
	1927	1928	1927	1928	1927	1928	1927	1928
Jan.	13.910	10.863	101.200	123.620	109.520	79.280	99.820	69.280
Feb.	14.509	.....	101.727	.....	107.545	.....	99.295	.....
March	12.801	.....	110.259	.....	108.000	.....	100.426	.....
April	14.166	.....	123.250	.....	101.885	.....	91.865	.....
May	12.975	.....	123.900	.....	84.680	.....	75.000	.....
June	12.447	.....	118.096	.....	72.000	.....	62.500	.....
July	11.880	.....	119.880	.....	72.000	.....	61.520	.....
Aug.	11.826	.....	119.111	.....	72.000	.....	62.000	.....
Sept.	11.073	.....	119.640	.....	72.000	.....	62.000	.....
Oct.	11.165	.....	126.200	.....	72.000	.....	62.000	.....
Nov.	10.763	.....	127.708	.....	72.000	.....	62.000	.....
Dec.	11.195	.....	126.933	.....	72.000	.....	62.000	.....
Year	12.393	.....	118.159	.....	84.636	.....	75.036	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. Prior to June, 1927, the unit had been the 75-lb. flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh, and Aluminum 98 Per Cent

	Bessemer		Basic		No. 2 Foundry		Aluminum	
	1927	1928	1927	1928	1927	1928	1927	1928
Jan.	21.04	.....	20.01	.....	20.26	.....	26.270	24.300
Feb.	20.76	.....	19.76	.....	20.26	.....	26.000	.....
March	21.15	.....	20.33	.....	20.26	.....	26.000	.....
April	21.26	.....	20.49	.....	20.26	.....	26.000	.....
May	20.94	.....	19.96	.....	20.26	.....	26.000	.....
June	20.66	.....	19.62	.....	20.11	.....	26.000	.....
July	20.26	.....	19.26	.....	19.76	.....	26.000	.....
Aug.	20.07	.....	19.01	.....	19.40	.....	26.000	.....
Sept.	19.96	.....	19.04	.....	19.46	.....	26.000	.....
Oct.	19.76	.....	18.76	.....	19.26	.....	25.600	.....
Nov.	19.64	.....	18.76	.....	19.23	.....	25.000	.....
Dec.	.....	.....	.....	.....	.....	.....	24.785	.....
Year	.....	.....	.....	.....	.....	.....	25.808	.....

Iron in dollars per long ton. Aluminum in cents per pound, 98 per cent grade.

Monthly Crude Copper Output in Short Tons

Domestic

	1927 July	Aug.	Sept.	Oct.	Nov.	Dec.
Alaska shipments	2,798	2,138	1,879	4,747	1,402	1,655
Butte & Superior	.....	.....	†284	.....	.....	.....
Calumet & Arizona	1,866	2,577	1,807	2,157	2,018	2,065
Magma	1,066	1,182	1,196	1,298	1,404	652
Miami	2,233	2,268	2,008	2,245	2,099	2,032
New Cornelia	2,496	3,039	3,137	3,718	3,613	3,607
Nevada Con	.....	.....	†26,298	.....	.....	.....
Old Dominion	825	850	931	871	832	801
Phelps Dodge††	7,706	7,366	7,779	7,770	7,799	7,757
United Verde Extension	1,868	1,905	1,813	1,933	1,698	1,930
Utah Copper	.....	.....	†27,786	.....	.....	.....
Tennessee Copper	408	445	412	532	594	617

Foreign

Andes Copper Mining Co.	2,370	2,367	2,367	2,367	2,367	.....
Braden	8,986	8,995	8,991	9,343	9,354	.....
Boleo, Mexico	1,215	1,067	852	990	990	1,001
Bwana M'Kubwa	337	366	336	496	447	494
Chile	9,005	9,020	8,934	8,954	8,960	.....
Furukawa, Japan	1,367	1,461	1,549	1,501	1,649	.....
Granby Cons., Canada	2,261	2,261	2,268	2,550	2,208	1,936
Mount Lyell, Aust.	.....	.....	†1,515	.....	.....	†2,064
Sumitomo, Japan	1,693	1,338	760	1,608	.....	.....
Union Miniere, Africa	8,065	8,008	9,075	10,230	10,890	10,803

†Three months.
††Moctezuma is included.

Monthly Production of Primary Copper from U. S. Mines and Daily Rate (Short Tons)

	1925 Monthly Production	1925 Daily Rate	1926 Monthly Production	1926 Daily Rate	1927 Monthly Production	1927 Daily Rate
January	74,789	2,412	71,026	2,291	76,198	2,458
February	68,967	2,463	68,131	2,433	69,202	2,472
March	74,901	2,416	75,728	2,443	69,314	2,236
April	70,667	2,356	73,454	2,448	71,122	2,371
May	70,574	2,276	73,542	2,372	71,613	2,310
June	59,894	2,330	71,317	2,377	69,539	2,318
July	68,507	2,210	72,228	2,330	65,545	2,114
August	68,090	2,196	72,014	2,323	67,248	2,169
September	67,720	2,272	72,672	2,421	65,936	2,198
October	71,042	2,292	75,099	2,423	68,595	2,225
November	67,400	2,247	74,947	2,498	68,080	2,269
December	69,566	2,244	72,205	2,329	67,377	2,173
Total	842,117	.....	872,509	.....	830,133	.....
Monthly average	70,176	.....	72,709	.....	69,178	.....
Average of daily rate	.....	2,307	.....	2,390	.....	2,274

Mining Stocks—Week Ended January 28, 1928

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	57⅛	55	55⅛	Ja.14, Fe.20 Q	0.75
Arcadian Consol	Boston	4	3 7/16	3⅜		
Ariz. Com'l	Boston	5½	5⅛	5	Ja. 19, Ja. 31	0.25
Calumet & Arizona	New York	109	103½	105½	De. 3, De. 9 Q	1.50
Calumet & Hecla	Boston	22½	21½	22	No.30, De.15 Q	0.50
Cerro de Pasco	New York	67½	65½	64½	Ja.12, Fe.8 Q	1.00
Chile Copper	New York	41⅛	40½	40⅜	Ma. 2, Ma. 30Q	0.62½
Con. Coppermines	N. Y. Curb	5½	5⅜	5⅜		
Copper Range	Boston	19½	18	18½	Ap.2, My.2, A	1.00
Crystal Copper	Boston Curb	*64	*59	*61		
East Butte	Boston	2	1⅞	1⅞	Dec. 1919	0.50
Granby Consol	New York	42⅜	40½	40⅝	Ja.15 Jy. 1 Q	1.00
Greene Cananea	New York	146½	133½	140⅜	Nov., 1920	0.50
Howe Sound	New York	44	42½	42½	De.31, Ja.16, Q	1.00
Inspiration Consol	New York	20½	18⅜	19⅜	Ma.17, Ap.4, Q	0.25
Iron Cap	Boston Curb	2⅛	2½	2⅛		
Isle Royale	Boston	14⅜	13⅞	14	Fe. 28, Ma. 15 Q	0.50
Kennecott	New York	84⅛	82	82⅜	De. 2, Ja 3 Q	1.25
Magma Copper	New York	53	50⅜	51	De.30, Ja.17 Q	0.75
Mason Valley	N. Y. Curb	1⅞	1⅝	1⅞		
Miami Copper	New York	18⅞	18⅛	18⅛	Fe.1, Fe.15, Q	0.37½
Mohawk	Boston	49⅞	48	48⅛	Ja. 28, Ma. 1 Q	1.00
Montana-Idaho	Spokane	*48½	*47	*48½		
Mother Lode Coal	New York	2⅞	2⅜	2⅜	De.16, De.31	0.25
Nevada Consol	New York	19	17⅞	18⅛	De.16, De.31 Q	0.37½
New Cornelia	Boston	28½	27⅜	28⅛	Fe. 3, Fe. 20 Q	0.50
Noranda	N. Y. Curb	22	21	21½		
North Butte	Boston	1⅜	1⅛	1⅛	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	1.00	*92	*94	Sept. 1926	0.03
Old Dominion	Boston	11⅜	11⅛	11⅛	Dec., 1918	1.00
Phelps Dodge	N. Y. Curb	128	124⅜	125½	De.17, Ja.3 Q	1.50
Quincy	Boston	14⅜	13⅛	14⅛	March, 1920	1.00
St. Mary's Min. Ld	Boston	31	29	29⅛	Fe.10, Ma.10	2.00
Seneca Copper	New York	2⅛	2⅛	2⅛		
Shattuck-Denn	Boston Curb	9⅜	8	9⅜		
Tenn. C. & C	New York	11½	10⅜	11	No.30, De.15, Q	0.12½
United Verde Ex	N. Y. Curb	...	...	25	Ja.4, Fe.1 Q	0.50
Utah Copper	New York	...	...	145	De.16, De.31 Q	1.50
Utah Metal & T	Boston	1 3/16	1⅛	1⅛	Dec., 1917	0.30
Walker Mining	Salt Lake	*73	*65	*72		
NICKEL-COPPER						
Internat. Nickel	New York	99⅜	94⅜	97⅜	De.16, De.31 Q	0.50
Internat. Nickel pfd	New York	...	...	110⅜	Fe. 17, Ma. 1 Q	0.62½
LEAD						
Gladstone Mtn	Spokane	*15	*12½	*13½	June, 1927	0.005
National Lead	New York	132⅞	129½	132⅝	De. 16, De. 31 Q	1.25
National Lead pfd	New York	139	139	139	Ma. 2, Ma. 15Q	1.75
St. Joseph Lead	New York	43	41⅛	42	Ma.9, Ma.20, QX	0.75
ZINC						
Am. Z. L. & S	New York	8⅜	7½	8⅛	May, 1917	1.00
Am. Z. L. & S. pfd	New York	54⅛	44⅛	52⅜	Nov., 1920	1.50
Butte C. & Z	New York	4⅛	4⅛	4⅛	De. 9, De. 24	0.50
Butte & Superior	New York	9⅛	9⅛	9⅛	De.16, De.31 Q	0.50
Callahan Zn-Ld	New York	2⅜	2⅛	2⅛	Dec., 1920	0.50
Consol.Lead&Zinc'A'	St. Louis	14⅛	14	14	Ma.15, Ap.1 Q	0.25
Eagle-Picher	Cincinnati	21⅛	21	21⅛	No.15, De.1 Q	0.40
Eagle-Picher pfd	Cincinnati	...	...	117½	Jn.30, Oc.15 Q	1.50
New Jersey Zn	N. Y. Curb	186	184	185½	Ja. 20, Fe. 10	2.00
United Zinc	N. Y. Curb	...	...	25		
Yellow Pine	Los Angeles	*25	25	*25	Dec. 1925 Q	0.04
GOLD						
Alaska Juneau	New York	3⅜	2⅜	2⅞		
Argonaut	Toronto	*27½	*24	*26½		
Barry-Hollinger	Toronto	1.02	*87	*88		
Central Manitoba	Toronto	1.77	1.71	1.76		
Con.W.Dome L.new.	Toronto	*16	*13½	*13½		
Cresson Consol. G	N. Y. Curb	2⅛	2	2 1/16	De. 31, Ja.10 Q	0.10
Dome Mines	New York	13	12⅛	12⅜	Ma. 31, Ap. 20Q	0.25
Golden Cycle	Colo.Springs	†1.75	†1.74	...	No.30, De.10 Q	0.04
Gold Hill	Toronto	*32½	*30	*32½		
Hollinger Consol	Toronto	17.90	17.50	17.50	Ja.1, Ja.27 M	0.10
Homestake Mining	New York	70	69½	70	Ja.20, Ja.27 MX	1.50
Kirkland Lake	Toronto	2.43	2.29	2.36		
Lake Shore	Toronto	25.95	24.00	24.50	De.1, De.15 QX	0.20
McIntyre-Porcupine	New York	...	...	27½	Fe. 1, Ma. 1 Q	0.25
Portland	Colo.Springs	†*25	†*19½	...	Ap.6, Ap.15, Q	0.02
Rand Mines	New York	...	...	43½	Au.22-29 Am.Sh.	1.52
Sylvanite	Toronto	3.40	3.30	3.30		
Teck-Hughes	Toronto	9.75	8.40	9.00	Fe.1, X	0.15
Tom Reed	Los Angeles	*36	*26	*26	Dec., 1926	0.02
Tough-Oakes	Toronto	*70	*63	*64½		
United Eastern	N. Y. Curb	*69	*60	*65	July, 1924	0.05
Vipond Cons	Toronto	*66	*54	*57	Apr.1, Apr.15	0.03
Wright-Hargreaves	Toronto	6.05	5 60	5.65	Ja. 17, Fe. 1	0.05
GOLD AND SILVER						
Carnegie Metals	Pittsburgh	26⅜	23½	25		
Con. Cortes	N. Y. Curb	*19	*19	*19		
Dolores Esperanza	N. Y. Curb	...	...	*50	July, 1923	0.05
Premier Gold	N. Y. Curb	3½	2⅜	2⅜	De. 15, Ja. 4	0.08
Tonopah Belmont	N. Y. Curb	1⅜	1⅛	1⅛	Ma.15, Ap.4	0.08
Tonopah Extension	N. Y. Curb	*13	*10	*10	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	3⅜	3⅛	3⅛	Se.20, Oc.21	0.07½
West End Consol	N. Y. Curb	*6	*5	*5	Mar., 1923	0.05
Yukon Gold	Boston Curb	*70	*60	*63	June, 1918	0.02
SILVER						
Beaver Consol	Toronto	1.96	1 91	1.92	May, 1920	0.03
Castle-Trethewey	Toronto	*71½	*65	*65		
Coniagas	Toronto	4.85	4.80	4.85	May, 1924	0.12½
Keeley	Toronto	*65	*53	*55	Se.1, Se.15	0.08
Lorrain Trout Lake	Toronto			*60	July, 1925	0.05
Mining Corp. Can	Toronto	5.35	4.85	4.85	Ja.10, Ja.25	1.50
Nipissing	N. Y. Curb	5⅜	5⅛	5⅛	De. 31, Ja.20 Q	0.07½

Stock	Exch.	High	Low	Last		Last Di
SILVER-LEAD						
Ahumada	New York	3½	3	3	Ma. 25, Ap.4, QX	0.12½
Bingham Mines	Boston	...	...	54	Ja. 21, Fe. 1 Q	0.95
BunkerHill&Sullivan	N. Y. Curb	160	152	154½	Ja.31, Fe.4 NX	0.75
Cardiff M. & M	Salt Lake	*81	*81	*81	F b 5, 1927	0.10
Chief Consol	Salt Lake	3.55	3.25	3.55	Ja.10, Fe.1 Q	0.10
Consti'nMng.&Mill'g	Spokane	*26	*20	*22		
Erupcion	Boston Curb	*50	*45	*49	De.17, Ja.3 Q	0.07½
Eureka Lily	Salt Lake	1.87½	1.77½	1.85		
Federal M. & S	New York	...	...	147½	Jn.25, Jn.29 Spec.	$10
Federal M. & S pfd	New York	94	94	94	No. 12 De 15 Q	0.25
Hecla Mining	N. Y. Curb	18	18	18	No.15, De.15 Q	1.75
Highland-Surprise	Spokane	*16	*15	*15½		
Iron King Mining	Salt Lake	*59	*58	*59		
Keystone Mining	Salt Lake	...	...	*27	Au. 12, Au. 26	0.07½
Lucky Jim	Spokane	*38	*32½	*32½		
Lucky Tiger-Com	Kansas City	†8.10	†7.85	...	De.10, De. 20 X	0.12
Mammoth Mining	Salt Lake	2.25	2.00	2.00	Jn.10, Jn.20 Q	0.05
North Lily	Salt Lake	4.15	2.87½	4.05		
Park Utah	New York	13½	11⅞	12	De. 15, Ja. 3 Q	0.20
Plutus Mining	Salt Lake	2.25	2.25	2.25	Oc. 25, No. 10 Q	0.10
Silver King Coal	Salt Lake	13.50	11.25	11.25	De. 24, Ja.2 X	0.35
Silversmith	Spokane	*28	*24½	*24½	Oct., 1926 Q	0.02
Strattons Mines	Spokane	*58	*48	*54		
Sunshine M. Co	Spokane	1.64	1.45	1.52		
Tamarack-Custer	Spokane	1.24	*83½	1.14	Sept., 1924	0.25
Tintic Standard	Salt Lake	16.37½	15.50	15.75	De.20, Ja.3 QX	0.40
Utah-Apex	Boston	5	4⅜	4⅜	Oct., 1926	0.25
IRON						
Bethlehem Steel	New York	59½	57	57⅛	Se. 2, Oc.1	1.75
Cleveland-Cliffs Iron	Cleveland	110	104	105	Ja.13, Ja.25. Q	1.00
Colorado Fuel & Iron	New York	82⅛	78	82⅜	May, 1921	0.75
Gt. North'n Iron Ore	New York	25	24	24½	Dec. 6, Dec. 28	0.75
Inland Steel	New York	60	57	57½	No. 15, De. 1 Q	0.62½
Replogle Steel	New York	...	...	12½		
Republic I. & S	New York	65⅞	61⅜	62½	Fe. 15, Ma. 1 Q	1.00
Republic I. & S. pfd	New York	110½	107½	110½	Ma. 15, Ap. 2 Q	1.75
Sloss-Sheffield S. & I.	New York	128	121	127	De. 10, De. 20 Q	1.50
Sloss-Shef. S.&I. pfd	New York	...	...	110	De. 20, Ja.3 Q	1.75
U. S. Steel	New York	149⅜	145	146⅜	No. 30, De. 30 Q	1.75
U. S. Steel, pfd	New York	141	139½	140⅜	Oc.30, No. 29 Q	1.75
Virginia I. C. & C	New York	...	...	38	Jan., 1924	1.50
Virginia I.C.&C. pfd	New York	...	...	62⅜	De. 16, Ja. 3	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN						
De Beers Consol	New York	...	...	24	Jn. 26, Jn.30	1.45
So. Am. G. & P. New	N. Y. Curb	3	3	3		
Alum. Co. of Amer	N. Y. Curb	129⅞	122	128½		
Alum. Co. ofAmer.pf	N. Y. Curb	106⅜	106⅛	106½	De. 15, Ja1 Q	1.50
Vanadium Corp	New York	74⅜	65½	71⅛	Fe. 1, Fe. 15 Q	0.75
Patino M. & E	New York	28⅜	24⅛	28	De. 31, Ja. 14	4e.
ASBESTOS						
Asbestos Corp	Montreal	34	33½	33⅜	Jan., 1926	1.50
Asbestos Corp. pfd	Montreal	93½	93	93¼	De.31, Ja.16 Q	1.75
SULPHUR						
Freeport Texas	New York	105⅜	102½	103½	Ja.14, Fe.1 QX	1.75
Texas Gulf	New York	77⅛	74⅛	74⅜	De. 1, De. 15 Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	45⅛	43½	43⅜	Fe.18, Ma.1 Q	0.75
Amer. Metal, pfd	New York	116	114½	115⅛	Fe.18, Ma.1 Q	1.75
Amer. Sm. & Ref	New York	180½	175½	176½	De.31, Fe. 1 Q	2.00
Amer. Sm. & Ref. pfd	New York	134½	133	134½	De.31, Ma.1 Q	1.75
Consol. M. & S	Montreal	289½	265	284	De. 31, Ja. 16 X	6.25
Newmont Mining	N. Y. Curb	158	150½	151	Ja.3, Ja. 17	1.00
U. S. Sm. R. & M	New York	43⅜	41½	42	Ja. 6, Ja. 14 Q	0.87½
U.S. Sm. R.&M. pfd	New York	53	52½	53	Ja. 6, . J3 14 Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. F, four weeks. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED JANUARY 17, 1928

Name	High	Low	Last	Date	Amount	Last Div.
Aramayo Mines (25 frs.)	75/—	72/6	73/9	Nov., 1927	5	p.c. (†)
British Platinum (£1)	—/3	—/1½	—/3	Feb., 1925	2½	p.c.
Burma Corpn. (10 rupees)	14/3	13/10½	14/—	Jan., 1928	6	annas*
Bwana M'Kubwa (5s)	5/—	4/4½	4/9			
Camp Bird (2s)	4/6	3/3	3/9			
El Oro (£1)	3/1½	3/—	3/1½	Nov., 1924	2½	p.c.*
Esperanza (10s)	—/1½	—/1½	—/1½			
Frontino & Bolivia (£1)	14/3	13/9	13/9	Jan., 1928	5	p.c.
Mexican Corpn. (£1)	9/3	8/—	9/—			
Mexico Mines of El Oro (£1)	17/6	13/9	17/6	Dec., 1926	3½	p.c.*
N'Changa Copper Mining	11/—	10/—	11/—			
Oroville Dredging (£1)	4/3	3/10½	4/3	Dec., 1923	3½	p.c.
Ouro Preto (£1)	2/6	2/3	2/6	May, 1925	2½	p.c.
Rhodesian Congo Border (£1)	29/4½	27/6	28/9			
St. John del Rey (£1)	10/—	9/9	10/—	May, 1927	3½	p.c.
San Francisco Mines (10s)	28/6	26/—	26/3	Jan, 1928	25s.	
Santa Gertrudis (£1)	17/—	15/3	16/—	Jan., 1928	7½	p.c
Selukwe (2s. 6d.)	8/1½	7/9	7/9	April, 1917	6¼	p.c
S. Amer. Copper (2s.)	—/9	—/4½	—/9	Nov., 1917	75	p.c
Tanganyika (£1)	76/6	67/6	67/6	Aug., 1927	7½	p.c
Union Miniere du Haut-Katanga (Brussels)	12.675	12.400	12.525	July, 1927	182.60	(‡)

* Free of British income tax. † Swiss francs and plus 15 p. c. bonus. ‡ Belgian frs. and free of taxation.